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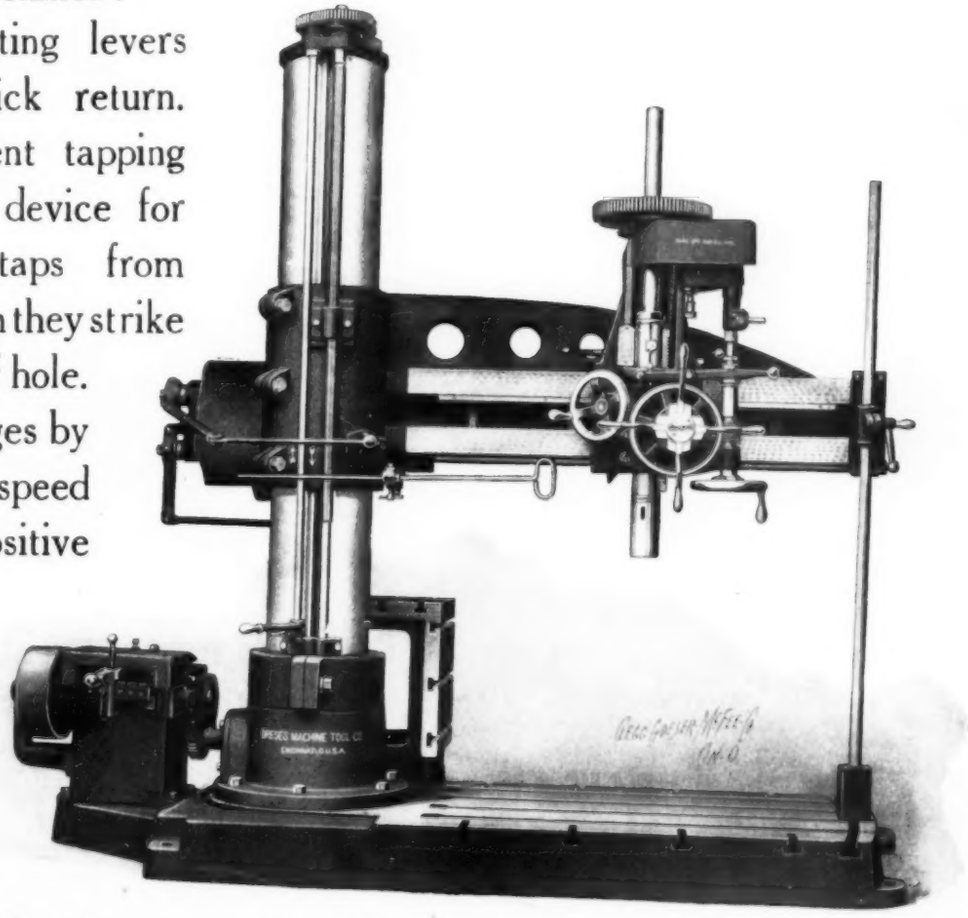

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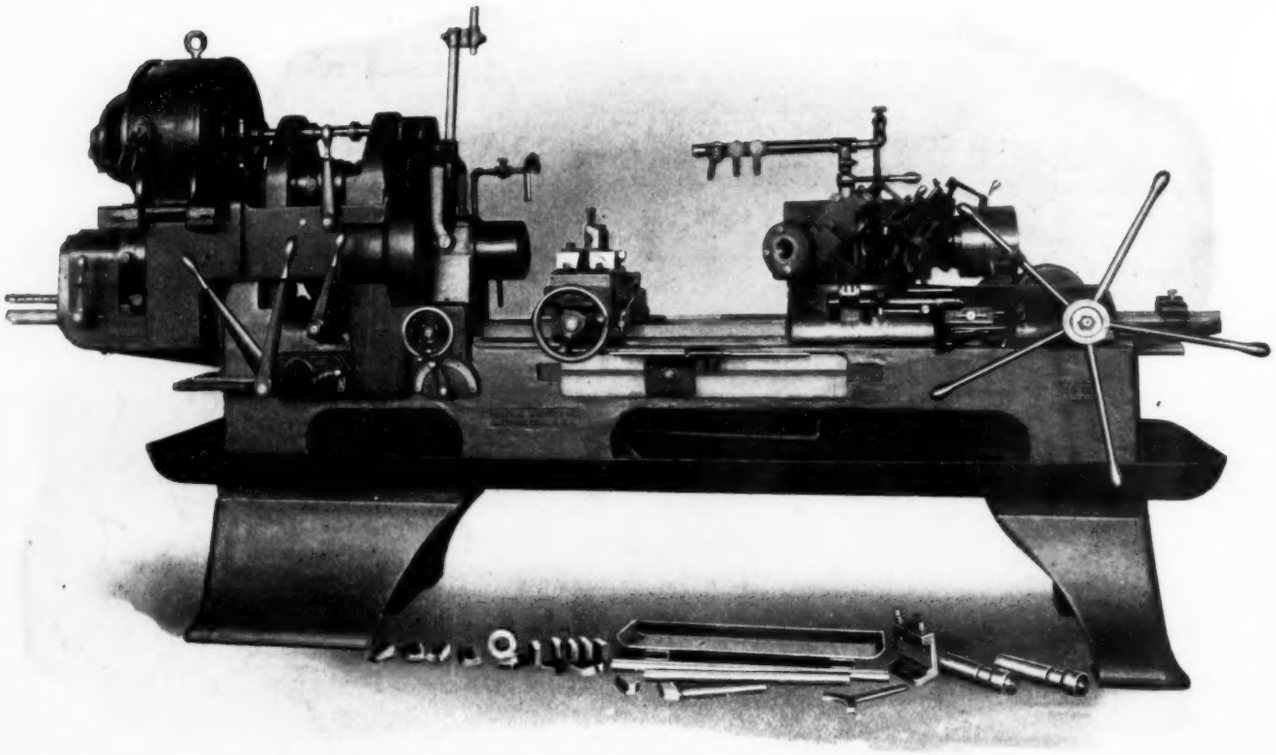

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The Passing of the Freeland Tool Works.

Old-time mechanics will learn with a pang of regret that the Freeland Tool Works is no more. This old-time shop, which was, in its early days, one of the leading American machine-tool works, has been finally dismantled and except as noted later, the old tools were sold by auction April 26.

THE HISTORY OF THE WORKS.

The works were founded by A. M. Freeland, who began business in the most modest way in Mangin street of this city about 1845. Ten years later he removed to Yonkers where, however, he remained but a few months and then returned to New York where he built the rear portion of the building at 558 and 560 W. 34th street and in 1857 he built the front portion, shown in Fig. 1, which has been continuously occupied from that day to the final closing. The rear or first portion is also still standing, its use during recent years having been as a blacksmith shop.

FIG. 1. THE FREELAND TOOL WORKS THAT WAS.

Mr. Freeland conducted the business until his death in 1871, after which it was operated for his estate for a couple of years when it was bought by some of the employees who operated it for several years under the firm name of Thomas & Co., the shop being rechristened the Freeland Tool Works as shown by the sign over the main entrance. Thomas & Co., whose advertisement appeared in the columns of this paper during its early years, continued the tool business for a time but soon began building rock drills and the smaller sizes of air compressors for the Rand Drill Company, and, as this business grew in importance, the compressor work became a more and more important part of and eventually became their chief product. The works were then bought by the Rand Company, the former members of the Thomas firm being continued as managers of the shop. Mr. Rand always had an affection for the old works and continued to call it the Freeland Tool Works as the still existing sign will indicate.

The consolidation of the Rand with the Ingersoll Drill Company has led to a change of policy, the modern tools having been removed to other shops of the new company, while the old tools, except those shown in Figs. 2, 3, 4, 6, 7 and 8, have been sold. When their attention was called to the fact that these tools were examples of the beginnings of high-grade tool production in this country, the Ingersoll-Rand Company generously withdrew them from sale and presented them as objects of historical interest to the American Society of Mechanical Engineers.

OLD-TIME EMPLOYEES.

Of the members of the firm of Thomas & Co. two have continued with the Rand Company and its successor until the present time. Of these the oldest in point of connection with the works is William McFaul, who entered the shop as an apprentice in 1857, receiving as wages 5 cents per hour with the agrement that the rate would be advanced one cent per hour each year, and he served under this agreement for about five years. The shop hours were fifty-nine per week, but the wages for the lost hour of Saturday were deducted. Mr. McFaul has been located for some years in San Francisco as the local representative of the Rand and Ingersoll-Rand companies, from whence he returned at the first opportunity after the eathquake and fire. Another old-time employee, G. B. Seddon, has been continuously connected with the shop since 1862, and for many years has been its superintendent. He entered the shop as a journeyman, with the expectation of spending a few months there in order to gain experience in a superior grade of work, but those few months have stretched out to forty-four years, and have made him one of the best known figures in that part of the city.

Joshua Rose, well known to many of the present generation as one of the earliest American writers on machine-shop practice, and one who, in his time, did much to spread the gospel of correct and advanced practice, was another graduate of the old days from these works.

FIG. 3. WHITWORTH MASTER SCREW—1857.

MR. FREELAND AS A DISCIPLE OF WHITWORTH

Mr. Freeland was a disciple of Whitworth—by no means a slavish copyist, but one who looked upon the Whitworth works as the great exponent of correct practice. In general design his tools were of the Whitworth school, as the illustrations show. An old contract with the Whitworth works, dating from the early 50's, was recently discovered, by which Mr. Freeland agreed to pay 1800 pounds sterling for certain improvements in lathes. The money was to have been paid after the improvements had been tested, and it does not appear whether or no the

payment was ever actually made. Before building this shop Mr. Freeland went to England to study the practice of the Whitworth works, and as one result he ordered the set of Whitworth plug-and-ring gages shown in Fig. 2, which are still in existence and in excellent order. They run up to 2 inches—by 16ths to 1 inch and then by 8ths to 2 inches. They have never been tested with a modern measuring machine and their degree of accuracy is unknown. They are, however, strictly consistent with one another, the 5/8 and 3/8 or the 3/4 and 1/4-inch plugs filling exactly the one-inch ring and so for

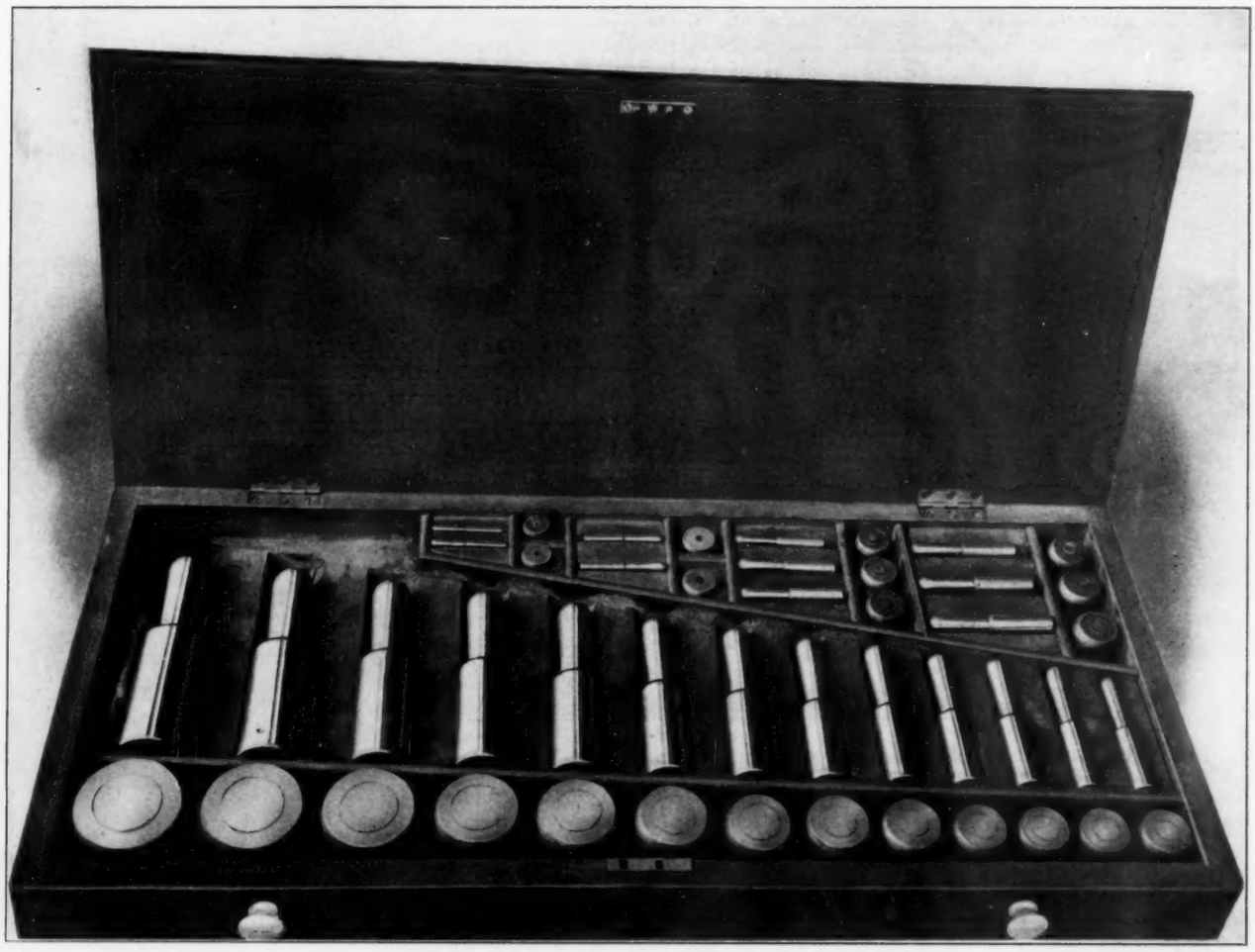


FIG. 2. WHITWORTH PLUG AND RING GAGES—1857.

any combination that may be made among them. Another purchase made during this same trip was the Whitworth master screw shown in Fig. 3. This screw was used for finishing the lead screws of all Freeland lathes and, like the gages, is still in existence. Its length is 19 feet, the threaded portion being but 15 feet.

Of the date of purchase of the gages and screw, as of some of the other things to be noted, there is no record, the only datum points in some cases being the entrance of Messrs. McFaul and Seddon into the works. Of some things all that they can say is that they were there when they came. Inasmuch, however, as Mr. McFaul helped to build the front portion of the building, and as this was erected immediately after Mr. Freeland's return from England, its date, 1857, obviously fixes the time of importation of the screw and gages.

The purchase of the gages and screw at that early date will indicate better than any words could the standard of workmanship which Mr. Freeland set for himself. He was probably the first in this country to introduce the then new Whitworth process of scraping. Mr. Seddon says that at his entrance into the shop in 1862 all lathe beds, as well as the cross rails of planers and other flat surfaces, were scraped as a regular thing, and not to one another but to surface plates originated in the works. The adoption of this process was undoubtedly a result of the trip to England and hence, doubtless, antedates Mr. Seddon's knowledge of it.

SOME NOTEWORTHY OLD TOOLS.

Of the tools in the shop the one to carry the oldest date is the planer shown in Fig. 4, which carries the date 1852. The large planer shown in Fig. 5 is but two years younger and was a remarkable tool for its time. Its original size was 42x42 inches by 16 feet, but it was subsequently widened to its present size of 50 inches, and the length of both bed and table were increased to give a cut of 24 feet. Both these tools have been used continuously. In their housings they seem light in design, but no one may say that they are not still capable of excellent service, while they were head and shoulders above the usual pattern of chain-driven machines of their time. They have a quick return and, except that they carry but a single head, have all the usual fittings and adjustments of the planers of today. Mr. Freeland was one of the first to adopt the rack-driving system, as he was one of the first to develop the differential shifting motion for two-belt planers. Old books of his are still in existence showing the payment of royalties for the use of his belt-shifting mechanism by Bement & Dougherty and by Hewes & Phillips.

The small planer has an interesting drive, which is only partly shown in the illustration. It is driven by a single belt shifting over three pulleys, of which the middle one is the idler, the outer one driving for the cutting stroke through a pinion and the internal gear shown projecting above the table and supported by a stout bracket, while the return is by a spur of smaller diameter mounted on the same shaft as the internal gear and meshing with a second spur on the inner pulley. The reversal of motion and the

quick return are thus accomplished in the simplest possible manner. The tripping piece, by which the platen dogs shift the belt, is swiveled on the bolt directly in front of the housing, and this tripping piece also operates the feed, as was universal at that time. The main rack and bull wheel have herringbone teeth and the elevating screws for the cross rail will be seen by a glance at the bevel gears at their upper ends to be both of the same hand—an arrangement which is now finding favor with some builders after having been forgotten for many years.

bed so as to divide the chip between the tools. The rear tool was, of course, used upside down. This lathe, it should be remarked, has no rack traverse to the carriage, the feed-screw being made to do the work of a rack by a pinion meshing in its lower side.

EARLY GRINDING PRACTICE.

This lathe has a hardened and ground spindle, as had all of Mr. Freeland's lathes. The boxes are of gun metal, and no one in the works can recall that they have ever been refitted for wear. Mr. Freeland's early practice with lathe spindles is a curious commentary on the scarcity of steel at that time, and an eloquent one on his standard of workmanship. The body of the spindle was of iron to which staves of blister steel were welded for the bearing surfaces, and then hardened and ground. Needless to say this required expert blacksmith work, and it was no unusual thing for five spindles from a lot of six to prove defective, and to be defective was to insure rejection. The expense of this process led Mr. Freeland to experiment with other methods. He tried case-hardening in combination with a special hardening furnace which, for the final hardening, should heat the bearings only and thus have the other portions of the spindle soft, but this did not prove satisfactory, and eventually he adopted the process of turning the bearings nearly to size, but leaving the other portions so large that the carbonizing would not penetrate deeper than the ultimate size. The spindle was then carbonized, after which the portions other than the bearings were turned down so as to remove the carbonizing. The entire spindle was then heated and quenched with the result that the bearings were hardened while the other portions were not, after which the bearings were ground by the fixture shown in Fig. 7, which is known to have been in existence in 1857, except that the original tail by which it was mounted in the tool post has been broken off and a new one substituted.

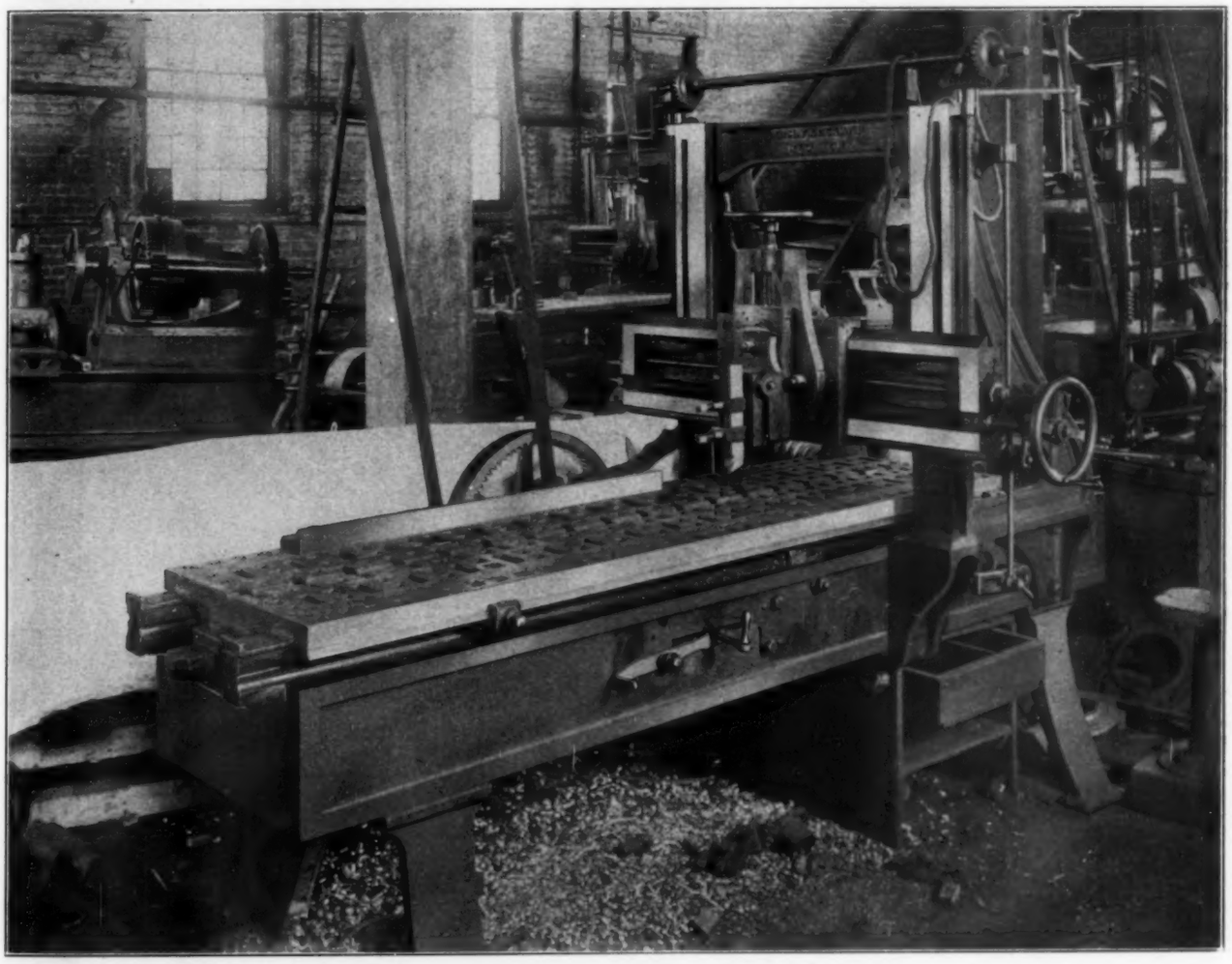


FIG. 4. FREELAND PLANER—1852.

Next in age to the small planer is the 20-inch—or, as Mr. Freeland always said, in English fashion, a 10-inch—lathe shown in Fig. 6 which carries the date 1853. The influence of Whitworth is seen in this machine more than in the others, as in addition to its lines is the flat-top bed which Mr. Freeland always used. The lathe has a second tool post in the rear, so as to fit it for carrying two tools. The two posts are connected by a right- and left-hand cross-feed screw with a short supplementary screw to the back post for independent adjustment of the tool to a depth of cut and a second short screw for adjusting the tool lengthwise of the

Of course this fixture antedates the emery wheel, and for a grinding wheel Mr. Freeland used a cast-iron disk with a babbitt ring on its circumference which was made to carry sufficient emery to do the grinding. The lathe shown has the steel stave type of bearing.

SOME MORE MODERN METHODS.

One of the most interesting of these

tools is the gear cutter shown in Fig. 8. The date of this is unknown, but it was in the shop when Mr. McFaul entered it. The most interesting features of it are the large worm wheel, which is of the split type, with the two halves bolted together and re-hobbed after shifting the halves in the most "modern" precision fashion, and the index mechanism, which is of the whole revolution type also, in general estimation, comparatively modern. Complete change gears are provided together

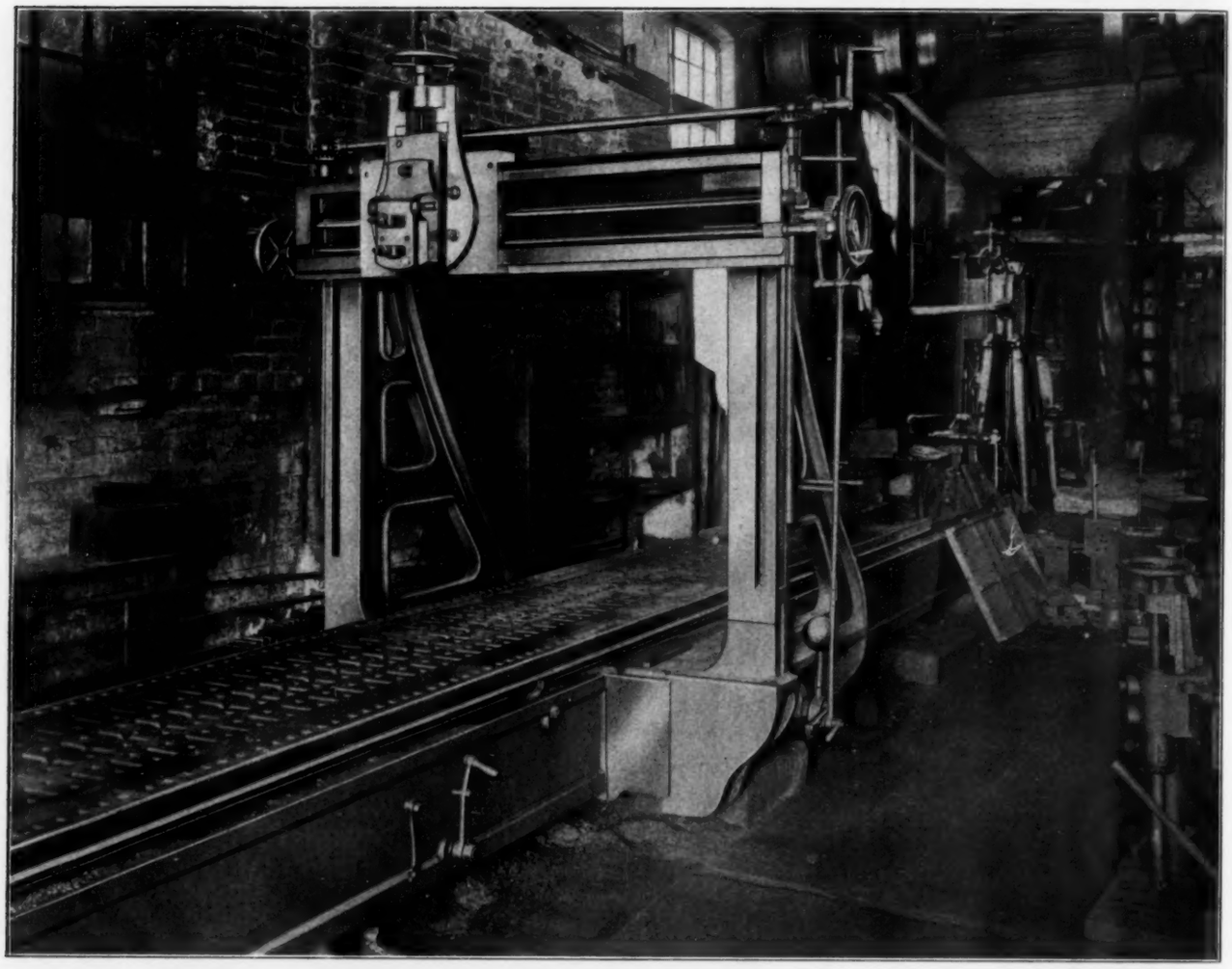


FIG. 5. FREELAND PLANER—1854.

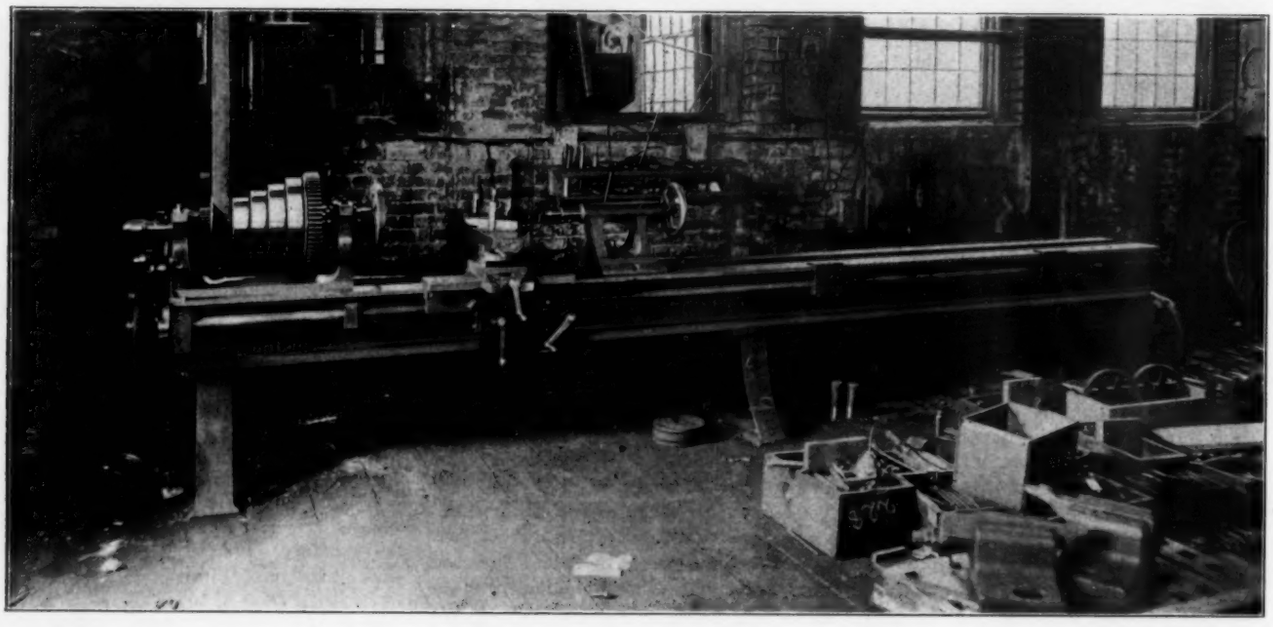
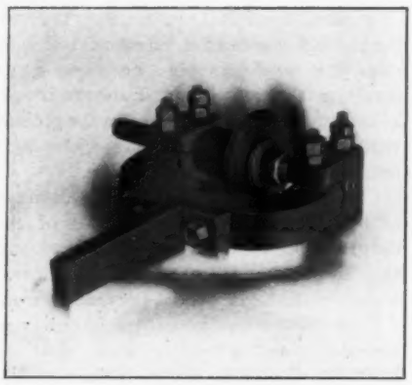


FIG. 6. FREELAND LATHE—1853.

with a brass index table, and, in use, such gears were selected as would give an exact number of turns to the index handle. As a check on the counting of the revolutions, a series of small index dials driven by a worm on the first motion index shaft



F.G. 7. FIXTURE FOR GRINDING LATHE SPINDLES, KNOWN TO HAVE BEEN IN USE IN 1857.

is provided, as clearly shown within the frame near the index crank, of which, in indexing, the graduations pass the zero mark as the required number of turns is completed. The screw which adjusts the cutter-carrying head to the work is provided with a micrometer dial for adjusting the depth of cut.

The machine will be seen to be arranged for cutting bevel wheels, the cutter-carrying upright being swiveled at its base to give the cone angle, and the plate which carries the cutter-carrying slide being swiveled to the upright to give the angle for cutting the sides of the teeth.

Fig. 9 shows a treadle drill press which also was in the shop in 1857, but of the date of origin of which nothing is known. This, like all the other tools, was in regular service to the end.

F. A. H.

A Big Casting and a Strong Car.

The development of power machinery of all kinds, leading, as it has, to the design of prime movers of constantly increasing capacities, has presented some difficult problem of transportation for the larger and heavier pieces of machinery, which have never before demanded solution.

The question of adequate carrying facilities for heavy engine parts has become more and more persistent with the growth of the present tendency toward giant units. The cars used heretofore for the purpose have been especially constructed of heavy material, and with a capacity of from 60 to 70 tons. This type of car is, in fact, identical with that employed by the Government for the transportation of heavy

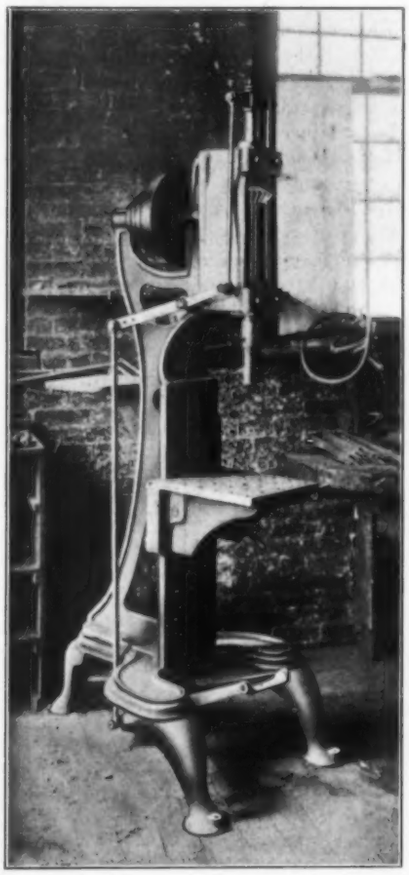


FIG. 9. TREADLE DRILL, KNOWN TO HAVE BEEN IN USE IN 1857.

ordnance. A new problem in transportation, however, confronted the Allis-Chalmers Company in the case of a huge frame and guide of a monster horizontal rolling-mill engine, designed for shipment to the Carnegie Steel Company's plant at Sharon, where it will be installed for heavy service. This single piece, which in the rough casting was of approximately 133 tons, will weigh considerably over 100 tons as a finished part for shipment. In seeking a suitable means for overcoming the difficulty of shipping such a piece, it was learned that no single car had ever been built capable of carrying it, and that a special car, designed especially for the purpose, would be the only possible solution. Accordingly orders were placed with the West Milwaukee car shops of the Chicago, Milwaukee & St. Paul Railway for two 16-wheel flat-cars of the required capacity, which are the first of their kind in existence. The car has two 4-wheel trucks at each end, the car body being directly supported at each end by a cradle which in turn rests upon the center plates of the two trucks at the end. A few details of construction, showing the un-

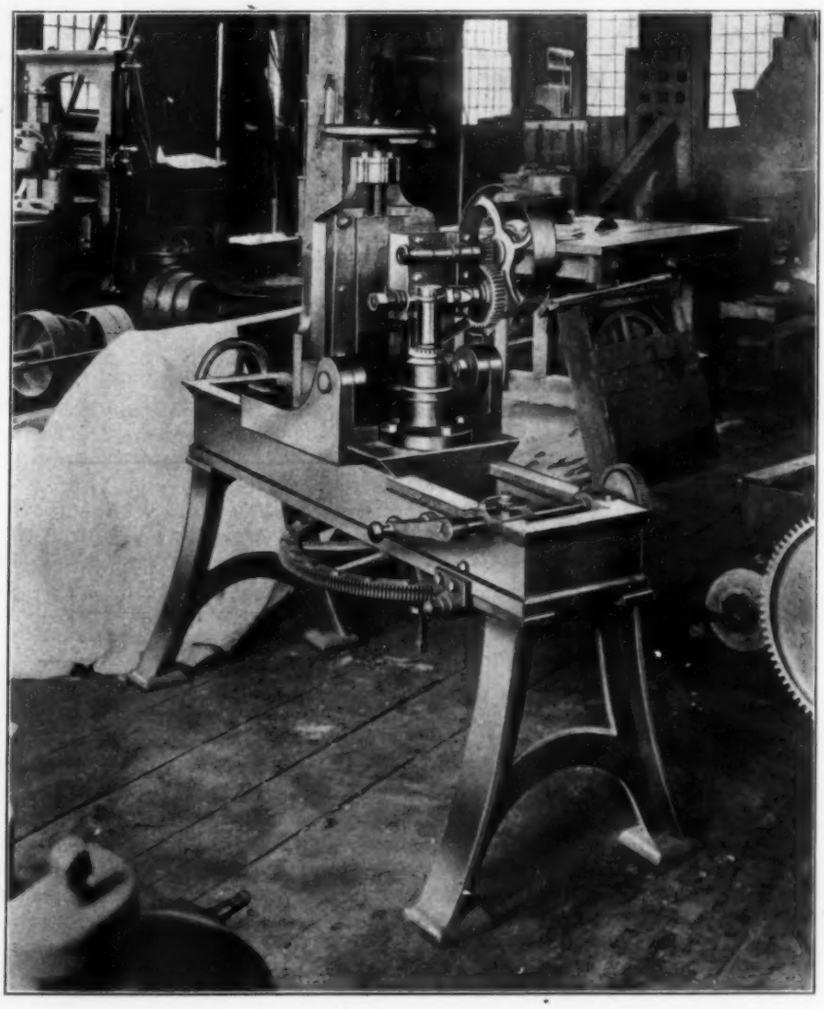


FIG. 8. FREELAND GEAR CUTTER, KNOWN TO HAVE BEEN IN USE IN 1857.

usual size of these new cars, are as follows:

Length over end sills	40′ 2″
Width over side sills	8′ 9″
Hight rail to floor	4′ 4½″
Wheel base	6′ 2″
Wheels diameter	33″ standard
Journals	5½″ x 10″
Weight of car estimated between 50 and 60 thousand pounds.	
Rated capacity	200,000 lb.

The cars are built as low as possible to allow all the clearance space obtainable.

It is decidedly advantageous in building a rolling-mill engine, with a capacity like the one in question, to design the frame and guide in a single piece for the purpose of securing the greatest possible rigidity and strength to withstand the racking strains of rolling-mill service. This piece in the Sharon engine is the heaviest single casting ever poured at the works of the Allis-Chalmers Company, where some of the heaviest steam-driven units in the world have had their origin. The pattern for this huge casting, measuring 32 feet long, 11 feet wide and 10 feet high, represented the work of ten expert pattern makers for a period of over four months' time; the amount of lumber of various kinds used for the purpose reached the astonishing aggregate of 22,000 feet. The pit dug in the floor of the foundry at the West Allis works in which this casting was poured was 40 feet long, 15 wide and 11 deep. The mold into which the molten metal was poured took approximately 133 tons of iron, the actual pouring of which consumed from eight to ten minutes. Nine ladles, four with a capacity of 25 tons each, one 13 tons and four, 5 tons each, were used in the operation.

It is worthy of note that the traffic department of the Allis-Chalmers Company, which regularly follows up all shipments by telegraph, after the special car has been properly tested and is finally ready, loaded for the journey eastward, will secure acceptance for transportation over the required route as "Special," that is with a special locomotive and picked crew, and only a sufficient number of additional cars to ballast the train.

Two Ways of Molding a Heavy Gap Press Body, at the Perkins Machine Company's Iron Foundry, Warren, Mass.

BY R. H. PALMER.

The illustrations show one of the many styles of gap-press bodies cast in the foundry of the above company, also the two different ways of molding them. Fig. 1 is the front view of the pattern; the line *A* running through the center is where the pattern is split to allow one-half to be molded in the cope, and the other in the drag, or, as some call it, the nowel. *B* is the print of the main core; *F* and *H* are prints for the core where the cross-head is to work; *D* and *C* are cores through the seat; *E*, cores through lugs. Fig. 2 is the side view of the pattern, the lettering of the prints being the same as in Fig. 1. *I*, Fig. 1, is the print for the name-plate core. *J* will be taken up later.

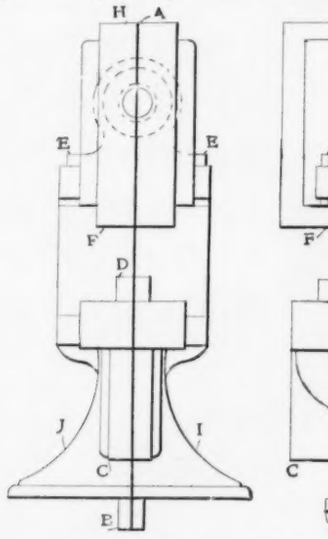


FIG. 1. FRONT VIEW OF PATTERN.

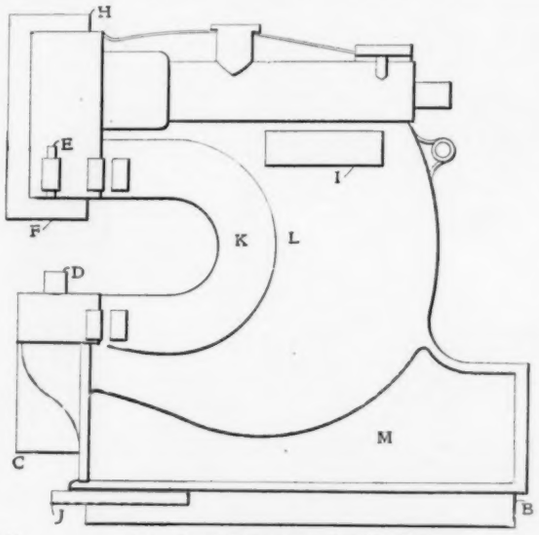


FIG. 2. SIDE VIEW OF PATTERN.

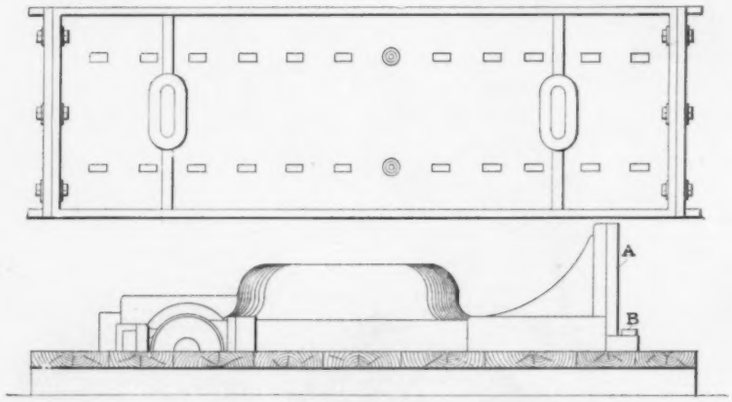


FIG. 3. THE DRAG PATTERN ON A MOLD BOARD.

Let us now consider the molding. The question is often asked, what are the advantages of bedding work in the foundry floor over molding it in tight flasks, or *vice versa*? In answer I would say, much depends on kind of castings wanted, the class of molders to be had, and where the foundry is located. In the city, ground rent is one important item; flasks must be stored somewhere when not in use. At some of the city foundries one may see derricks with piles of large flasks under them where heavy work is made; and it is the old saying at these foundries: "It is the bottom one that is always wanted." The piling up of flasks in this way reduces the ground rent and thus effects a saving in one way, perhaps; but the expense of handling is increased and, it may be found, goes quite a way toward paying the ground rent where land is obtainable—where it is not, one must do the best he can.

Consequently, in molding heavy castings in tight flasks we have the cost of the drag, the bottom board and the cope, and the cost of handling, storing and depreciation if made of wood. If made of iron, a large flask means considerable outlay at the start, and generally more cost in handling. But I do not mean here to discuss the relative merits of iron and wood.

Again the question is asked: "Does the ease with which most castings can be made in tight flasks offset the extra cost of drag and board?" In a part of the country where little work is bedded in, and in shops where every pattern is follow-boarded, even to comparatively very large patterns, the bedding-in work is looked on as a very expensive piece of business, and with men totally unaccustomed to it, it is so, and that is why I say, "much depends on the class of molders." I have seen men leave the East and go West, who have told me "they wanted to know something about bedding-in work." I have seen some jobs, in shops where the men were used to bedding-in work, bedded in the floor so quickly that I was surprised, and I have seen some molders spend so much time on a tight flask, where everything was fitted for them, that I was disgusted. The man who wishes to do a fair day's work, if unaccustomed to bedding-in work, will very quickly learn the way to start a job, and, once catching the idea, will soon show how quickly he can do the job; but the man who is satisfied to never try a new way is the one who will say, "you can't do it so well or so quickly," when you ask him to try the other way, be it either way. I have not found many molders of the last

kind in my life; I am glad to say I find the average molder is as receptive of new ideas as any other class of mechanics, and is looking for new ideas of how to do his work, not only so it will be more of a credit to him, but he takes a certain amount of pride in his employer's output, and will refer to such and such castings as made by himself. I believe when a man has a lot of men such as I have described, he will find bedding in the floor much of the work that is now made in tight flasks will be a profitable change. On the other hand there is much of the work that is made in tight flasks that cannot be made as profitably in any other way, and it is not that class of work to which I wish to refer.

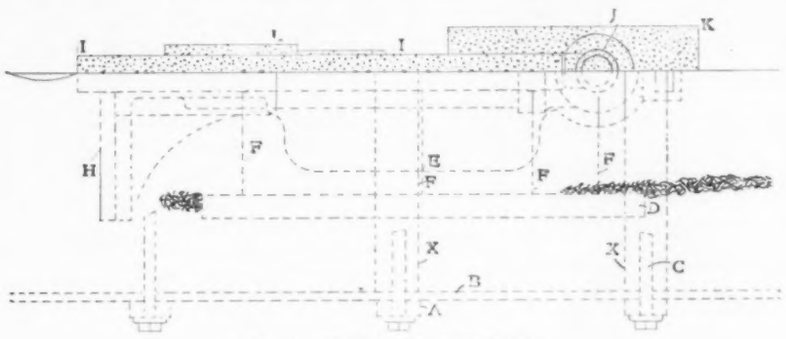


FIG. 4. BEDDING-IN THE DRAG.

MAKING THE DRAG ON A MOLD BOARD.

Fig. 3 shows the drag half of the pattern lying on the mold board ready to have the drag half of the flask placed around it, and with the core *A* placed against the pattern; this core is rammed up in the mold against the foot of the pattern thus forming a level foot on the casting. *B* is a flat bar of iron laid on the print for main core, and rammed up in the mold to form a solid bearing for core to rest on. These castings vary greatly in thickness, and it will be seen the casting is made for strength where strength is needed. The jaw *K* is cast solid while the part back of it as *L*, Fig. 2, is cast some 2¾ inches thick, and part *M*, ⅞ inch. Thus it will be seen the casting varies greatly in thickness in its different parts, yet I have never seen the least indication of checking, as the iron is mixed from chemical analysis for strength and toughness. In some of the castings part steel is used.

The sea-coal facing used on the thicker part above *M*, Fig. 2, is mixed by taking 28 parts of the following mixture: One part sea-coal, seven parts coarse molding sand, one part hill sand (quartz sand), and to the 28 parts add 1 part flour, and the whole is to be wet up with molasses water mixed 1 part molasses to 16 of water. This mixture is to be skin-dried after the mold is finished. On part *M*, the facing is mixed one of seacoal to ten parts sand, and is not skin-dried.

The drag is now rammed up say halfway, and then pieces of joist 4 inches by 5 inches are placed lengthways of the pattern, and the sand rammed around them. The mold is now given a good venting down to the pattern and the vents covered with cinders, and a channel-way formed leading to the side of the flask at which there is an opening for the gas to escape, and the channel-way filled with cinders. Paper is now covered over the cinders to keep the sand from getting into the cinders, and so closing off the escape of the gas. Sand is now rammed in to the top of the mold, or drag. The idea of placing the joist in the drag when partly rammed up is to have a chance to use a shorter-stemmed chaplet. Any molder knows what it is to have a long-stemmed chaplet work in a mold when he is setting a core on chaplets; a chaplet with a stem 15 inches long will spring around amazingly when one does not want it to, when setting a core; and having to move the core, if the stem is of small iron, gives all the more trouble.

The sand is struck off even with the drag, and loose sand is thrown on, and leveled off, then the board is put on, and rapped down to a bearing, or rubbed down. When found to have a proper bearing the whole is clamped together, and rolled over onto binders, then leveled at both ends, and held by wedging under cleats.

As we have now reached the point where we will make the joint, we find after that the process is the same in regard to ramming up the cope for both ways, so let us start the description of bedding-in, assuming that we have the pattern to start with.

BEDDING-IN THE DRAG.

In Fig. 4, we will find the pit is ready as far as starting the mold. It is some 16 feet long, by 10 feet wide, with four binders in the bottom—I have shown but three, as only three are needed for this job. On top of these binders are plates *B*, and running through the binders are eye-bolts *C*; these bolts after passing through binders, washers, and nuts are riveted down so there will not be any danger of the nuts beneath the binder being turned on the bolts when the upper nuts are being tightened to secure a cope. These eye-bolts extend to nearly the floor line, falling short some 5 inches so as to be out of the way. Extending from

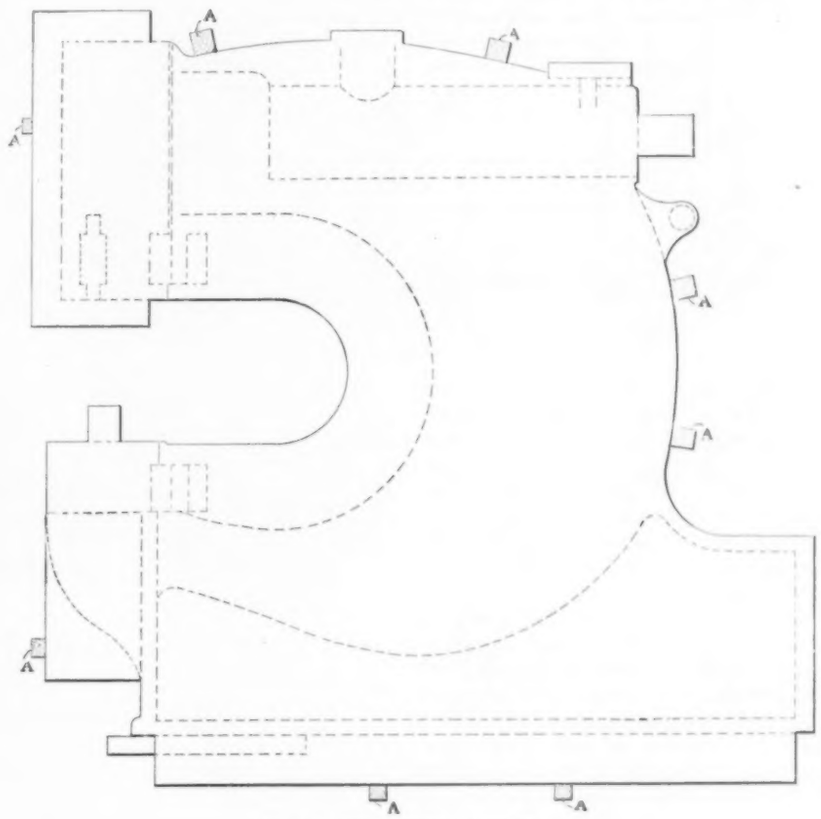


FIG. 5. THE NOWEL PATTERN.

the binders to the floor line are joists on which the cope is to rest, seen just inside the eyebolts at Fig. 4.

The pit being dug out, sand is rammed in up to joist *D*, which is to receive the chaplets when the core is set, and the cinder bed is put in between and around the joists, and connected with gas-pipe to carry off the gas, and cinders are rammed down; then covered with papers to keep the sand out of the cinders. Sand is now rammed on top of the paper almost up to the line *E*, as near as the molder can judge; as some molders can carry the form of a pattern in their heads better than others, they will come nearer to the shape of pit wanted.

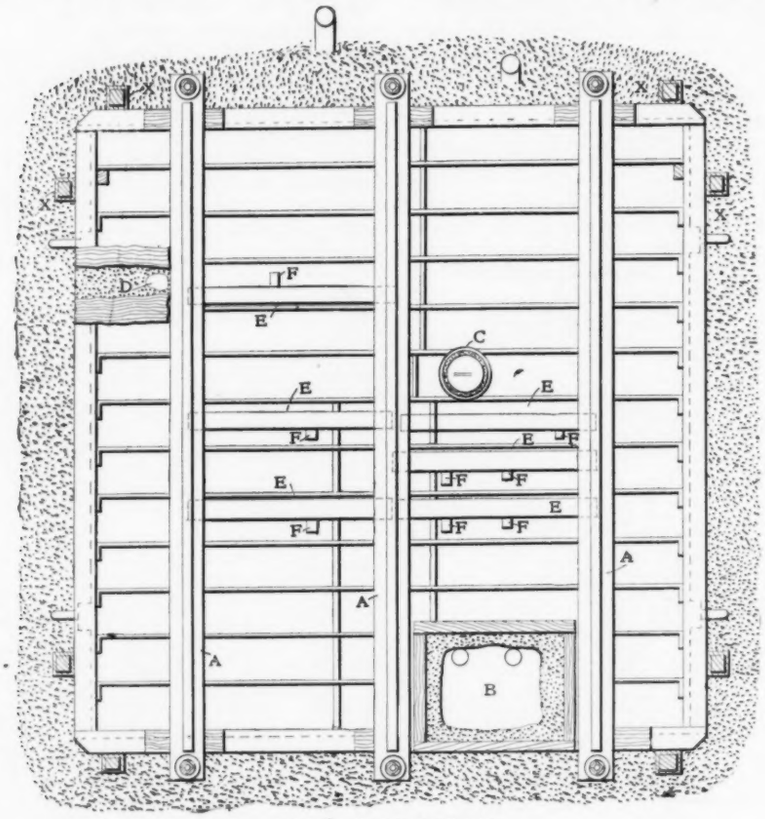


FIG. 6. PLAN OF MOLD.

The lower half of the pattern is now placed in the pit, and wedged up where wanted, if the pit is the right shape; if not, the pattern is removed, and the shape altered to suit, and pattern is replaced and leveled up at both ends and held by the wedges; the wedges to be removed as the sand is rammed up to them and pattern weighted. The core *H* is then stood up against the foot of pattern and the facing sand is rammed against the foot part of the pattern, and backed with black sand, and black sand is rammed against the core *H*; facing sand is also tucked and rammed under the part *E* of the pattern, and the sand rammed firmly around it; remember if this is not done it will show when the casting is cleaned, as this is the heavy, or thick part of the casting, and any neglect will speak for itself.

When the sand is rammed slightly above the line *E* around the rounding part of pattern it is vented as much as possible, care being taken that the vent wire punctures the papers over the cinders. The facing and ramming continues until the sand is to somewhere within about three inches of the body of the pattern, then the facing is tucked in under the pattern, but it is not rammed. At some parts of the pattern the black sand may come nearer, but the idea is to have room to tuck the facing under the pattern.

The pattern is now staked as shown at *A*, Fig. 5; the legs *I* and *J*, Fig. 1, are pinned onto the pattern, and in addition have stop-off pieces screwed onto the leg and pattern; these are now removed, and the pattern is taken from the pit. The whole mold is now given an extra good venting down through the paper to the the cinders, and then has about ¾ to 1 inch of facing sand spread over the surface; this is made to conform to the outline of the pattern; the pattern is now replaced and rapped down to a solid bearing, leveled and removed.

The whole surface is now felt over, and any soft spots found are filled, and the whole is finished to a certain extent, the pattern being then replaced. Stakes are drawn, and the sand is rammed up to the joint, and the joint made.

When using a tight flask we have pins to guide the cope onto the drag, but when we bed a pattern into the floor we must provide some guides to guide the cope on after we have removed it (or, as we say in the foundry, "hoisted it off") and wish to put it back. We place the cope half of the pattern on, and lower the cope down around it, and when we have gotten it in the right position we drive down the wooden staves to act as guides, see *X*, Fig. 6. The cope is then hoisted off, and the pattern and joint are covered with facing sand some three-quarters of an inch thick, and the core *H* is set against the foot. The cope is replaced,and the gate sticks and risers are set, then the gaggers, and the cope is rammed up. The core against the foot in the cope is held up by wires. The mold is now parted and finished. After finishing both parts are given a good coating of silver lead, and are then sprayed with molasses water, and let set some time so that the water may have time to soak in, as if the mold is too wet, when dried it will blister and peel off, and that means consirable work putting it back again. The chaplets *F*, Fig. 4, are now driven to a gage, and the core *I*, Fig. 4 is tried in, and taken out.

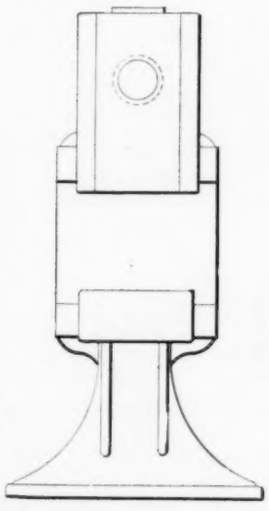


FIG. 7.

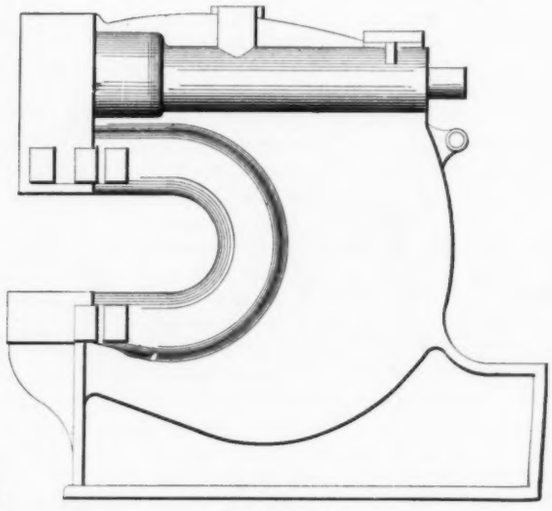


FIG. 8

GAP PRESS BODY CASTING.

DRYING OUT.

Bars of iron are then laid across the

mold, and on them sheets of iron; gasolene is then thrown under the sheets of iron on the mold, and set on fire; as the gasolene gives a very sharp quick heat, do not use too much at a time, and remember you are using a dangerous explosive. After seeing a mold fired with it once, one will know better what the effect of any carelessness will be. The mold is dried to a depth of some ¾ inch on its surface.

Core *I*, Fig. 4, is then set, then the lower half of core *K*, then core *J*, resting in it at one end, and upper half of *K* is closed on top of it; then core *L;* the core *E*, Fig. 2, is set when the mold is finished.

Pieces of clay worked to a point are set on core *I*, Fig. 4, where the chaplets are supposed to go, tipped with flour to leave their mark on the cope, and on core *J*, where a chaplet is also set. Parting sand is strewn back of the gates, and flour is scattered on the cores to show whether the cope bears on the cores rightly; vents are arranged. The cope is turned over and tried on,and hoisted off; at the spots where the cope is marked by the flour, the chaplets are placed if right; if not, the chaplet is changed to one side to make it right. Cores are pasted over on their prints. A skimmer is now wound with old rags soaked with oil, set on fire, and the skimmer held under the cope until the cope is dried to the depth wanted, and it is closed on.

CLOSING THE MOLD.

In the case of the tight flask the cope is secured with the binders and clamps.

In the case of bedding, the cope is secured by binding alone in the floor as I have referred to; in connection with binders *A*, Fig. 6.

The mold being secured, gate-sticks are set, and runner *B*, Fig. 6, is made up, also the riser *C* where the casting is to be pumped, and the flow-off, *D*. Binders *E*, Fig. 6, are placed over the chaplets extending under the binders *A*, and wedges *F* are pushed under them over the chaplets to hold the cores down.

The question may be asked, Why do we skin-dry the molds? We find the cost of skin-drying a mold is but little and the extra cost is more than saved in the cleaning of the heavier casting. The smaller sizes are made in green-sand facing mixed of the necessary strength to peel the castings, and given a coating of silver lead to insure a smooth clean surface.

Fig. 7 is a front view of the casting, and Fig. 8 is a side view. The weight is about 8000 pounds.

The five-masted bark "R. C. Rickmers," launched in Germany in February, is the largest sailing vessel in the world. Her length is 441 ft., width 54 ft. 3 in., and draft 26 ft. 9 in., displacement approximately 11,350 tons, and gross burden about 8000 tons. Though a sailing vessel, she has auxiliary steam power—a 1000-h.p. triple expansion engine, giving about 7 knots speed.

A Riveting Machine.

In certain classes of riveting machines a blow or series of blows is struck; for many kinds of work this is quite satisfactory, but for others it will not do, as the blow tends to upset the metal in the rivet and expand it below the head. In work where two or more pieces are to be riveted so that their surfaces are close together but so that they are free to slide or swing, the hammer riveting is apt to be unsatisfactory because the swinging or sliding parts may be jammed by the expanded body of the rivet. One manufacturer of this class of goods stated that 30 per cent.

FIG. 1. A RIVETING MACHINE.

of the articles riveted in this way would not pass inspection.

Another style of rivet machine has a cupped die which rotates at a high speed and burnishes the head on the rivet. The rivet machine shown at Fig. 1 is different from either of the forementioned; with it the head is formed by spinning with a pair of rollers.

At Fig. 2 the arrangement of these rollers and their action upon the rivet are shown. The taper shank *J* of the roller holder *A* fits in the hole in the end of the spindle. The two rollers *B* and *C* run on the stud *D*. They are made of tool steel shaped to conform to the contour of the rivet head *E* and hardened, *H* and *I* are two members to be riveted together. *G* is the anvil cupped at the top to suit the head of the rivet. At *K* is shown the rivet before the head is spun over. It has been found in practice that the friction between the anvil *G* and the head *F* is greater than that between the rollers *B C* and the rivet head being formed, so there is no tendency of the rivet to turn in the hole.

The spindle quill in the machine shown at Fig. 1 has a vertical movement by foot lever of 5/16 inch, the table is roughly adjusted to hight on the column, the final adjustment being made by the anvil. When not required, the anvil can be lowered so that the face of the table is clear. The thrust during the riveting operation is taken by a ball thrust bearing on the end of the quill. The spindle is counterbalanced by a spiral

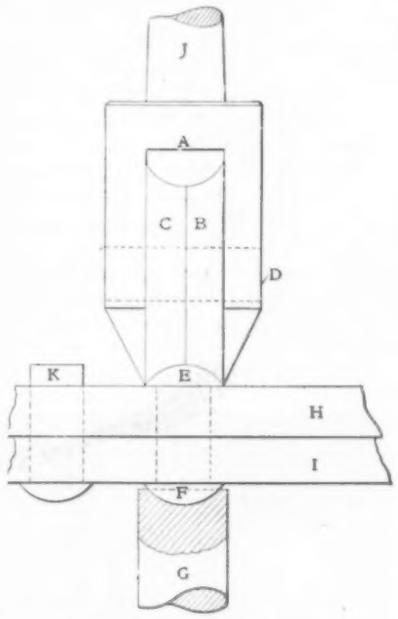


FIG. 2. THE SPINNING HEAD.

spring and the foot lever is pivoted so that when the foot pressure is released it returns the quill to its highest position by gravity, thus making the machine very sensitive.

The capacity of the machine is ⅜ inch and under for brass, and 5/16 inch and under for steel rivets; any length rivet up to 25 inches may be headed. Changing from one size head to another of course, requires the changing of the rolls; this can be accomplished in three minutes. The time necessary to rivet a head is stated as not over one second, thus it would seem that the time necessary to rivet a certain piece of work is governed by the speed with which the operator can handle the pieces.

For such work as automobile lamp work a horn is provided so that the rivet is inserted with the head on the inside, the machine spinning a similar head on the outside.

The work is said to be perfectly smooth

and without tool marks. The table of the machine is 8 inches square; all bearings are phosphor bronze; the spindle is ground; all parts subject to wear are hardened.

This machine is made by The Grant Manufacturing and Machine Company, Bridgeport, Conn.

A Relieving Attachment for the Lathe.

BY H. J. WHITE.

The accompanying engravings show a very successful arrangement for relieving taps and cutters that was designed by me some time ago and applied to a 14-inch Reed lathe.

The principal object was to back off taps of which quite a number of special ones were made ranging in size from ⅞ inch to 2¾ inches diameter. The previous practice was to relieve with a file which was a laborious and time-killing job. The device was simple to make and cost inside of $60. The regular gears furnished with the lathe are used and meet all our requirements; the table, however, specifies some combinations, the gears for which are not included in the set though they can be readily procured. It will be noted also that the compounding gear is used when relieving cutters, while single gearing is used on taps or anything having few teeth to relieve.

The general arrangement is shown in

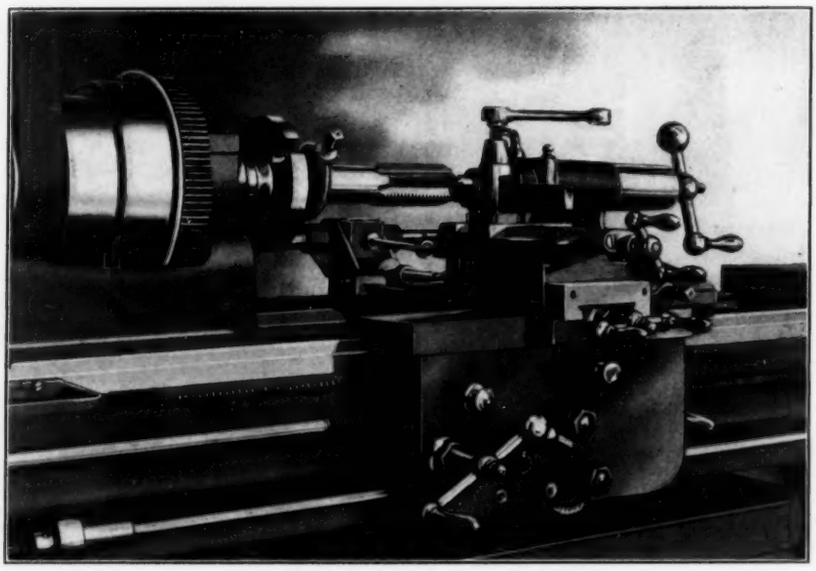


FIG. 1. LATHE WITH RELIEVING ATTACHMENT.

Figs. 1 and 2 and as represented in the latter view a bracket bearing is fastened to the lathe bed directly back of the headstock and so located that an arm carrying a gear acting as an intermediate can be readily adjusted to bring gears of different diameters in the train in mesh. Running in and supported by this bracket is a shaft 1 3/16 inches diameter which is splined a suitable distance for a ¼-inch key and carries the cam. This end of the shaft is carried in a bracket which is fastened by a pinch bolt to the rear portion of the guide on which the tool slide travels. Upon inspection of the small parts shown in Fig. 3, two square blocks having holes of the same diameter as the shaft will be seen, also an open frame or yoke in which these blocks slide; between these blocks the cam upon the shaft works. A stem extending from this rectangular frame connects with the tool slide from which the feed screw has been removed. Forcing the tool slide forward against spring pressure before coupling it up brings the roll in the rear of the frame against the cam. The screw holding the stem of this piece is then tightened up and the device is ready to operate.

It will be seen that the spring pressure keeps the tool away from the work while the cam action draws the tool in. The cut or amount of clearance given is exactly what the cam has been designed to give while the return of the slide is instantaneous. The cutting action on either taps or cutters is from the front of the tooth, or rather beginning at the front of the tooth, and relieving toward the back. I have seen some devices arranged to begin the cut at the back of the tooth but I do not believe this to be the best way. A number of cams will be noted by referring to Fig. 3. These are all "two-

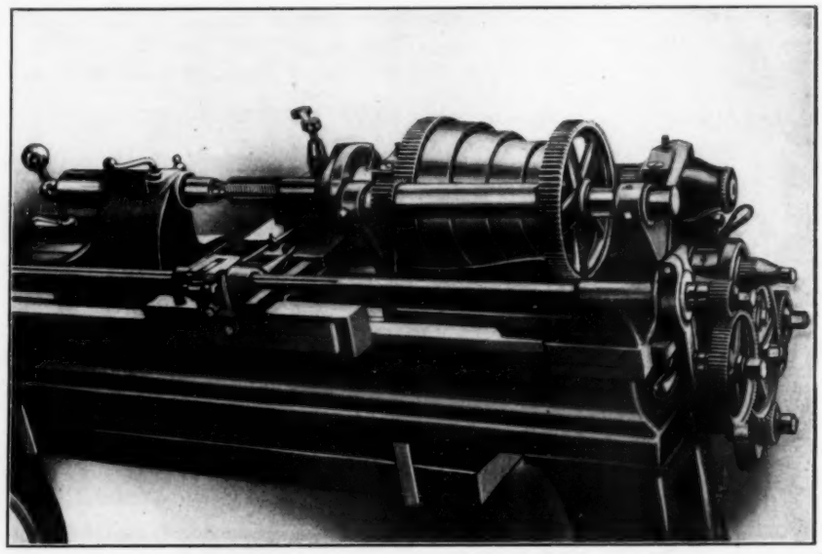


FIG. 2. REAR VIEW OF RELIEVING ATTACHMENT.

impulse" cams of various throws. The compression spring which keeps the tool away from the work is contained in the cam bracket, the sleeve extending from it forming means of adjustment for different diameters of work.

In the table and gear diagram the formulas are all based upon a two-impulse cam requiring one-half as many revolutions of the cam shaft as there are teeth in the tap or cutter. This is shown in the formula $V=\frac{g}{T}$. If a four-impulse cam were employed, the formula would read, $V=\frac{g}{4}$. In selecting gears from the table any two in corresponding position in the columns g and T may be used; that is, in the case, say, of 10 teeth in the cutter to back off, g may be 20 and T may be 50 teeth, g may be 22 and T may be 55 teeth, and so on. It will be understood that the velocity ratio of the stud to the lathe spindle is 1 to 1. It is a matter of simple calculation to deduct the factors for any desired result within the limits of the lathe.

When relieving taps, instead of reversing the lathe and running the carriage back by the screw, it will be found quicker and put less wear and tear on the device to open the nut and run back by hand, as most every good lathe hand knows how to do this and not even stop his machine.

In order to avoid confusion I wish to call attention to the fact that the front

view shows the cross-feed screw in place when it should have been removed; this was due to an oversight when the photograph was taken.

The Applied Science Reference Room of the Pratt Institute Library.

Practically everyone who plays a part of any importance in the conduct of construction and engineering enterprises realizes not only the value but the actual necessity of being acquainted with the technical literature of his particular line. Everything read in periodical literature or in books cannot, however, be permanently carried in the head, and all have had the experience of wanting to refer to something and not having the text available, and perhaps not even knowing in what it appeared. For these reasons it is to be hoped that the example set by the Pratt Institute Free Library, of Brooklyn, N. Y., will be followed in many localities. This library has established an "applied science reference room" for the purpose of aiding those engaged in any trade or industry, by providing for ready reference a collection of books, periodicals and transactions of societies, and trade catalogs, relating to engineering and the trades.

In the room set aside for this work are taken nearly a hundred trade and scientific papers, giving the latest news of the industrial world. There are besides over fifty of the labor-union papers, of which a file is preserved. The most important of the periodicals are bound, and these bound files contain much material that can be found nowhere else. The publications of the United States Patent Office are kept here also and are used daily. The collection of books here includes up-to-date publications in various industries, such as electrical engineering in all its branches, plumbing, manufacture of textiles, industrial chemistry, gas engines, the making of cement, etc., etc. The books in this room are not allowed to go out, so that anyone coming in is sure to find the book he wishes to refer to, if it is a part of this collection. The library has, however, a good collection of books in these subjects for circulation, often duplicates of the books in the applied science reference room. The room is in charge of Edwin M. Jenks, whose work is to help those who are looking up any question that lies within the province of this room. A large collection of trade catalogs furnishes the very latest information in many lines, and is being enlarged constantly. The library will get any trade catalog in print at the request of any user of the library, if it is obtainable by that institution.

One new feature of the room is a collection of mounted cuts of machines and mechanical devices. These may be used in the room or taken away to work with, if desired. A man looking up a new form of chuck, for example, will find a score of cuts showing different chucks, and among these may well find some that will be of service to him.

Men studying in the evening schools, those preparing for civil-service or other examinations, lawyers, and men of various interests will find this department of use. It is open every day, except Sunday, from 12:30 p.m. to 9:30 p.m., and can be used between 9 a.m. and 12:30 through the library office.

The library is situated on Ryerson street, between DeKalb and Willoughby avenues, Brooklyn, and may be reached by DeKalb avenue, Myrtle avenue, Greenpoint or Ralph avenue surface lines, or by the Myrtle and Lexington avenue "L" lines, which have stations at Grand avenue, one block above Ryerson street.

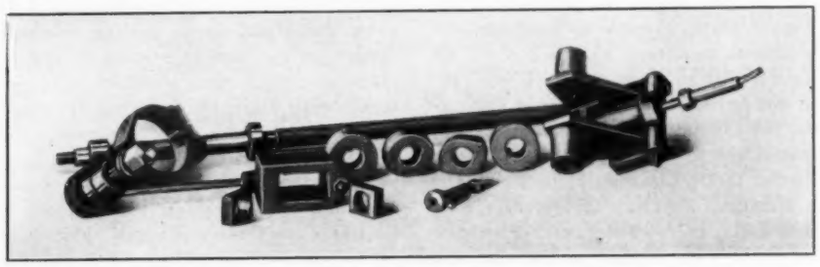
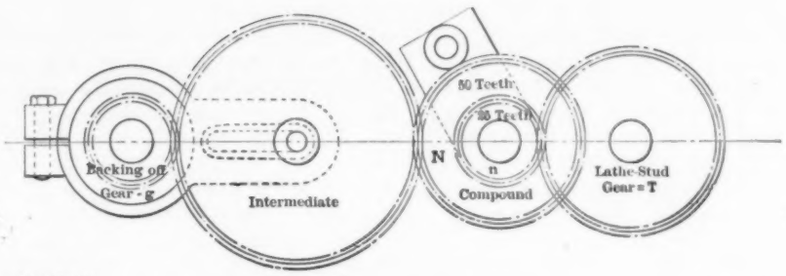


FIG. 3. ATTACHMENT TAKEN APART.



Gear Formulas for Cutters

$$g = \frac{I \times N}{n}$$

$$S = \frac{C}{2} \text{ or } \frac{T}{2} \times \frac{N}{n} \times S$$

$$T = \frac{I \times S}{N} \times n$$

g = Cam Shaft Gear
T = Lathe Stud Gear
n = No. Teeth in Compound Fixture
N = " " " = Gear
S = Rev's of Cam Shaft
C = No. Teeth in Cutter

GEARING FOR CUTTERS Any Two Consecutive Gears USING COMPOUND			
No. Teeth in Cutter	S-R's of C.	g-Cam Gear	T-Stud Gear
10	5	20-22-24-28	50-55-60-65
12	6	20-25-30-35	60-75-90-105
14	7	20-24-30	70-84-105
16	8	20-22-24-28	80-88-96-100
18	9	20-22-24	90 99-108
20	10	20-25	100-125
22	11		
24	12		
26	13		
28	14		
30	15		
32	16		
34	17		

GEARING FOR TAPS, REAMERS ETC. Any Two Consecutive Gears NOT USING COMPOUND		
F-No Teeth	g-Cam Gear	T-Stud Gear
1	60-60-80	25-30-40
2	25-30-40-50-60-70	25-30-40-50-60-70
3	20-30-40-50	30-45-60-75
4	20-25-30-40	40-50-60-80
5	20-30-40-50	50-75 100-125
6	20-25-30-40	60-75-90 120
7	20-30	70-105
8	20-30	80-120
9	20	90

Gear Formulas for Taps, Reamers

$$V = \frac{F}{2}$$

$$g = \frac{T}{V}$$

$$T = g \times V$$

F = No Grooves or Teeth in Tap
V = Vel. Ratio of Gears
T = No. Teeth in Stud Gear
g = " " Cam Gear

TABLE SHOWING CHANGE GEARS FOR RELIEVING ATTACHMENT ON 14-INCH REED LATHE.

Comparative Tests of Thermit Welds.

Tests have been recently made at the Fore River Shipbuilding Company's works, Quincy, Mass., in order to ascertain the strength of welds made by the use of thermit, relative to that of the material welded. Bars of rolled steel 2x4½ inches were drilled, broken and welded with thermit, and standard test bars were cut from the center of the weld; and as a basis of comparison, test bars were also cut from the unwelded portions of the stock. The results showed that the strength of the weld was not much inferior to that of the stock. In one case the stock had an elastic limit of 38,500 lb., and the weld 32,000 lb.; tensile strength of stock 60,500 lb., and of the weld 59,000 lb. In another case the stock had an elastic limit of 36,850 lb., and the weld, 33,700 lb.; tensile strength of stock 63,400 lb., and of weld 61,800 lb.

Malleable Cast Iron—Errata.

The author of the article at page 458 on Malleable Cast Iron, wishes to call attention to some errors in his manuscript which found their way into print. At page 460, middle column, near the bottom, for 7 per cent. read 0.07 per cent. At the third column of the same page, near the middle, for shrinkages of 1¼ and ⅝ inch to the foot read to the yard.

The new $32,000 railroad Young Men's Christian Association Building at Collinwood, O., was opened May 1, upon which occasion W. C. Brown, vice-president of the New York Central lines, made an address summarizing the progress of transportation, especially in the State of New York, and referring to the origin in Cleveland, in 1873, of the work of the Young Men's Christian Association among railroad men, and the inauguration of the first railroad branch.

Turpentine is good to make a pair of rolls take hold of sheet metal.

Alloys of Nickel and Steel.

The Institution of Mechanical Engineers of London has a committee on alloys and an abstract of a report of the committee is thus given by *The Engineer*.

The report is of a formidable character, and occupies some 103 pages. An abstract will be found in another place in this issue. After the secretary had read extracts of it, and the President had called for the usual vote of thanks to the authors—Dr. Carpenter, Mr. R. A. Hadfield, and Mr. Percy Longmuir—Dr. Carpenter threw on the screen the Mico-photographs shown on Plates 1 and 2. The total magnification was as high as 9000, and the slides were very striking.

Mr. Hadfield, in opening the discussion, said that great credit was due to Dr. Carpenter and Mr. Longmuir for the clear manner in which they had issued the report, thus making it of considerable value. He did not accept all the theoretical conclusions stated therein, but it was only natural, in a long report of that character, that there should be statements to which exception would be taken. The report, in his opinion, was a proof of the great value of the work done by the National Physical Laboratory. He drew attention to the regularity of the percentage of carbon present in the steel, which varied only from 0.52 to 0.4 per cent. No fewer than eight to ten casts of the metal had been made, and every precaution had been taken to keep the percentage constant. The carbon content was greatly different from that adopted by M. Guillet, which was 0.8 per cent. Attention was then drawn to the results given in Table XVII. This, he said, was a remarkable series of tests, for it showed that a tensile stress of 75 tons per square inch had been obtained by a material that had not been forged or mechanically treated in any way. There was also sufficient elongation to show that the metal was not wanting in ductility. Further, he stated that the metal gave the greatest known electrical resistance, and was a very bad conductor of heat. Since the report had been drawn up, he had had a number of specimens of nickel steel tested at liquid air temperature, and the results obtained were most remarkable. A number of these tests were referred to. The steel B, in Table II., which contained 1.20 per cent. of nickel, under ordinary conditions gave a maximum tensile strength of 40.93 tons per square inch, but when tested at the temperature of liquid air, the maximum stress rose to 75.4 tons, and the percentage elongation became 7.5. Steel C, with 2.15 per cent. of nickel, originally gave 41.52 tons per square inch, and elongation of 24.5 per cent. Under the new conditions these figures became 95.1 tons per square inch, and 12.7 respectively. In another instance when the steel contained 6.42 per cent. of nickel, the maximum stress was 110.57, and elongation nil. The same steel tested at liquid air temperature had a tensile strength of 142.2 tons per square inch, and an elongation of 2.5 per cent. But a still more remarkable result was obtained with sample J. This steel, containing 15.98 per cent. of nickel, gave a tensile stress of 80.24 tons per square inch, and elongation of 5.5 per cent. under ordinary conditions. When tested at liquid air temperature, the tensile stress increased to 144.2 tons per square inch, and the elongation became 2.5 per cent. Finally, the tensile strength of the sample K, containing 19.91 per cent. of nickel, rose from 43.92 to 157.2 tons per square inch, whilst the elongation, though it dropped considerably, was still as high as 15.5 per cent.

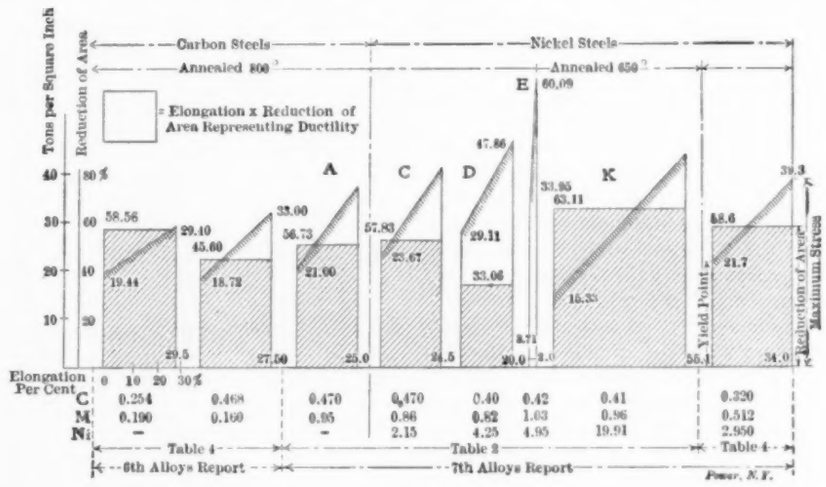
Sir William White, the president of the Alloys Research Committee, congratulated the authors upon their excellent work. He observed that although the work was carried out at the National Physical Laboratory, the Institution had given substantial financial aid to the undertaking. Thanks were due to Dr. Glazebrook, the director of the National Physical Laboratory for his untiring help in all work connected with the report. He was pleased to say that the Committee had the support of Professor Arnold, from whom the suggestion that Mr. Longmuir should take an active part in the research work had emanated. He looked upon the report in the light of a steel user and not a steel maker, and he thought it showed some of the possibilities the nickel steelmakers had before them. However, it must not be forgotten that cost, as in all cases, would be the predominating factor, at all events with regard to the more general use of such alloys. He drew attention to the extremely small variations in the percentage of manganese in the steels. No doubt it was wise not to make the change too much; nevertheless, he would like to have seen nickel steel with a greater variation in manganese tested. Continuing, Sir William White discussed the question of corrosion of this steel. He suggested that, in the point of view of the user it is of no value to express the percentage in terms of total weight—as is done in the report, but that this fact ought to be translated into surface loss; also a comparison ought to be made with ordinary mild steel. The report, he thought, was a treasury of information, and would be used as the standard work on this subject for many years to come.

The next speaker, Professor Turner, said that the previous reports issued by the Committee had been greatly appreciated, and that he felt sure the present report was in no way behind the others. Three conclusions had been arrived at, which, although not new, amplified present knowledge on the subject. The first was that there was a brittle zone in nickel steel alloys, the position of which depended upon the proportion of carbon. The second was that for each proportion of carbon there was a definite zone. The third was the remarkable occurrence of arrest point in the heating and cooling curves, shown on Diagram 18 accompanying the report. It was most interesting to see that as the parts of nickel increase, so also did the arrest points increase, until the remarkable result was obtained that the arrest points occurred at temperatures below 100 degrees. Whilst discussing this cooling curve, he reminded the members that nearly one hundred years ago certain high carbon steel could be partly tempered by plunging into boiling water. He considered that in future investigations carried out by the Alloys Research Committee, larger quantities of material should, if possible, be used. For instance, it might have been an advantage to duplicate the tests of several of the pieces. He further wished to know if it would not be possible to retain samples of the materials tested, so that in years to come, when standard tests are again being made, the investigators could test this steel under their own conditions, which would enable a better comparison to be made with the tests then being carried out. Referring to the method in which the hardness was tested, which was as follows:—"Two series of scratch tests were made with (1) a hardened steel point such as is used for marking scales, and (2) a diamond, both set of scratches representing standard conditions being made under a uniform load in a dividing engine." He said he had used this method for twenty years, and had never got good results. In fact, he had never known anyone use the microscopical method satisfactorily. The method he now employed consisted in taking a rectangular-shaped bar of metal and marking upon it several standard scratches. In order to obtain the hardness of any material, a scratch is made upon it, the point being loaded with a known weight, and the scratch obtained is compared with the standard scratches.

Captain Sankey desired to congratulate the authors on their very valuable contribution to the metallurgy of steel. No doubt a large portion of the paper was at present of greater scientific than practical interest, but it was full of material for the future study of those whose business it would to be perfect the nickel steels of commerce. Amongst minor points he called attention to the fact that these steels were "normalized" by annealing at a temperature of 800 deg. Cent., instead of at 620 deg. Cent., the annealing temperature adopted for this purpose for the tests recorded in the sixth alloys report. It was a question whether "normalized" was the proper term. He also called attention to the very small size of the tensile test pieces. They were only ⅜-in. diameter, and the elongation on 2-in. ought to be corrected to conform with the standard. The most practical salient point in the report, however, was the sudden change in properties which occurred somewhere in the neighborhood of 4½ per cent. nickel content. This was illustrated in Fig. 2, which showed very clearly what a very

small range of nickel content was practically useful. Up to about 2 per cent. the improvement over carbon steel was very slight, and shortly after 4 per cent. the dangerous zone was reached; between 2 and 4 per cent, was therefore the practical range, from which it would appear that the 3 per cent, to 3½ per cent. nickel steel of commerce was just about right. He asked the authors whether they had any information as to the uniformity of distribution or otherwise of the nickel in large ingots; it seemed to him that the point was of great importance, because if the distribution were not uniform it might so happen that the nickel content in certain portions might be in the critical range, and if such portions happened to be situated at a highly-stressed part of the piece of machinery, disaster might follow. He had prepared a diagram graphically to compare some of the steels of this report with some of those of the sixth alloys report, the yield point, the maximum stress, the elongation, and the reduction of area were shown on these diagrams in such a way as to exhibit at a glance the tensile qualities of the steel; the shaded area gave some idea of the ductility of steel. The first two figures were taken from the sixth alloys report, and showed the effect of increasing the carbon content from 0.254 to 0.468. The next figure represented the pure carbon steel of this report, and it would be seen that it was somewhat stronger than the former (both had been annealed at 800 deg. Cent.). The next three figures exhibited the effect of adding 2.15 per cent., 4.25 per cent., and 4.95 per cent. of nickel respectively, and showed very clearly the sudden change which took place between the last 2 per cent. of nickel. The next figure showed alloy K, with 19.91 per cent. of nickel, and exhibited the extraordinary ductility of this alloy. The last figure was one of the 3 per cent. nickel steels mentioned in Table IV., and it could be compared with the first figure owing to its somewhat similar carbon content (0.320 as against 0.254), showing a considerable improvement; it could also be compared with the 2.15 and 4.25 per cent. nickel steels of the present report, and it again showed up to advantage; but then it had been annealed at a different temperature, and the difference in the C and Mn content might also have some effect.

The shock tests described in the Report were, he thought, of great interest and the apparatus used was undoubtedly well suited for a research of this nature, but he did not think it could be applied for everyday workshop tests. Impact tests have been a fruitful source of discussion for some little time past, and there were numerous methods advocated, all of which, unfortunately, gave results which could not be compared. Thus the impact tests of this report were not comparable with those which he had made on some of the samples of the sixth alloys report. Undoubtedly, it was desirable that the advocates of these various methods should have free scope for a time, so as not to restrain individual efforts, but it seemed to him that the time had now come when some sort of co-ordination and standardisation of impact testing should be attempted, and with this object in view he would venture to suggest for the consideration of the Council whether a Committee could not be appointed by the Institution to settle this important matter.



CAPT. SANKEY'S DIAGRAM.

Mr. Harbord discussed the mechanical tests. He asked the authors to give a column showing the ratio of elastic limit to maximum stress. This, he thought, would be useful. Speaking of the forged alloys given in Table II. of the report, he was of opinion that they were of no practical use, as carbon steel, which was both better and cheaper, could be obtained. He did not know if the authors had taken the stress diagrams, in the tension tests, before the local elongation took place. If not, he thought they ought to have done so, especially when dealing with such small lengths as 2 in. In the section of the report dealing with "impact tests," it is stated that "the fact that the whole of the steels have not broken probably imparts to the results a greater value than if the fracture had occurred in each case, for . . . ." Mr. Harbord, in referring to this, said that although he did not dispute the statement, nevertheless it was disputable. He considered that test pieces, in order to give definite results, ought to break at one impact. He was in entire agreement with the remarks made by Captain Sankey relative to the standardisation of the impact test. If the Council decided to consider the matter, he offered to let them have numerous results that he had compiled which he thought might be of value to them. Finally, he briefly referred to the results obtained in the cold working experiments. These were of considerable theoretical interest. He believed that some mysterious change took place in cold workings. In this research work some definite results had been arrived at which were most interesting.

Mr. West, after saying a few words about Mr. Hadfield's tests at temperatures of liquid air, described an old test that used to be made many years ago. This consisted in heating the sample to a cherry heat and quenching it in water. But he was of opinion that this method was instituted by steel makers to make the steel more favorable for the future tests. He thought that it had an annealing effect upon the steel. Sir William White had spoken of corrosion. He—Mr. West—was of opinion that the thickness of the plate itself materially affected the surface corrosion. For thin plates were much more subject to shocks, vibration, and bending, which exposed new surfaces of the metal to attack. He stated that it was a matter of common knowledge that thin plates corroded more than thick plates. Mr. West also dwelt at some length on the strength of plates. Many years ago he was a strong advocate of high tension steel, and was not in favor of specifying two limits—maximum and minimum—for the tensile strength. For he argued that, provided you get the percentage alongation and bending you require what did it matter how great the tensile strength was? In fact, the higher the better. Since then, however, he had taken a different view of the case. The Admiralty and Lloyd's adopted two limits, which he now fully endorsed. For one thing, he thought it was exceedingly undesirable to have two different strengths of material connected together in the same structure, as undue strains were caused thereby. This in shipbuilding was certainly most detrimental, and should be avoided whenever possible.

Mr. Stromeyer supported Mr. Hadfield's cold temperature tests by saying that as we can now produce such cold tempera-

tures it is wise to know the behavior of metals under these conditions. This would greatly aid the designer in constructing machinery, etc., which would be subjected to these conditions. He was, therefore, strongly of opinion that physical tests should be carried out in a complete manner.

The President then adjourned the discussion until Friday evening. December 16th, when Professor Arnold would, he hoped, be present, and would take part in the discussion.

Upon this report our contemporary comments as follows:

The excellent report of the Alloys Research Committee which was read at the meeting of the Institution of Mechanical Engineers on Friday evening presents many points of considerable practical value to the engineer. One pronounced fact is the extraordinary influences of quite small changes in the composition of alloys of the kind tested. A glance at the diagrams shows that the addition of .7 per cent. of nickel suddenly converts the steel from one having fair tensile strength and ductility into an exceedingly hard and strong metal with only 2 per cent, elongation, a metal which breaks almost suddenly like a chisel, a defect which does not disappear by further additions of nickel till over 16 per cent. enters into the composition. The significance of the fact will not be missed. It must be borne in mind that the amount of metal used in these experiments was very small, and, no doubt, each ingot was homogeneous; but would it be possible, as Captain Sankey asked, to forge a shaft, for example, with a full certainty that the nickel content was either below 4.25 or so far exceeded it that the brittle zone was safely avoided and the qualities of the remarkable alloy K approached? If not, we might obviously have a forging of which the greater part was all that could be desired, whilst locally it might be as brittle as glass. Needless to say such a material would be nearly valueless, and one of the problems that the makers of this class of alloy for industrial purposes will have to solve will be the means of ensuring absolute homogeneity in metals that come anywhere near what we may describe as the danger zone.

A curious fact about the alloy K is emphasised by italics in the report. It is that the metal "is by no means easy to machine *except at the very beginning.*" The vibration caused by machining sets up in it a change of structure, and from a comparatively soft metal it becomes hard. An explanation is given of the fact, but we must not allow ourselves, as occasionally happens, to be blinded by it to the extraordinary phenomenon which is here presented. The fact has been recognized for many years and enforced by a hundred accidents that steel undergoes a pronounced advance towards brittleness by prolonged agitation, but we are unable to recall any previous instances of a metal changing its nature in the short time that is required to machine its surface. We are not prepared to say that such instances do not occur, and now that a reason for their occurrence has been adduced—the change from polyhedral to martensitic structure due to mechanical work—it may well be that we shall hear more of the appearance of unexpected hardness or hard spots in steels during machining. It is to be hoped that one or other of the authors of the paper may be able to pursue the inquiry further, and to tell us what are the conditions under which such a curious circumstance may arise. For example, what is the lowest percentage of nickel, if, as appears, it is the nickel that is responsible, that is essential to such unstability of nature? We are told that the alloys E to J are hard to machine on account of their martensitic structure. Alloy K, which differs mainly from F in having a great deal more nickel in its composition, has a polyhedral structure at first which rapidly changes to martensitic when it is machined. J also differs but little from K, save in nickel, of which it contains 4 per cent. more, but J is hard from the first. In this narrow range, then, of 4 per cent. the nature of the metal must change. It would, we venture to think, be not only interesting, but valuable, to pursue the inquiry into this particular problem further. K is an alloy with extraordinary properties; it is at present not likely to be used in the arts, but if ever it should be, the phenomenon to which the reporters have called attention, all too briefly, would demand earnest attention.

There is one other section of the report of great industrial importance. It refers to the corrosion of nickel steel. We are disposed to think that the reporters have not sufficiently considered the importance of this part of the inquiry which, considering the bearing it has upon the practical use of nickel alloys, is of greater moment than the micrographical investigation into which they go with great thoroughness. The general result at which they arrived is shown in a diagram which appears in the abstract of the report given on another page. Leaving out the sulphuric acid test, which is of little consequence, it will be seen that the resistance to corrosion in sea or fresh water, under the conditions of test, is practically constant for all the alloys—that is to say, that corrosion does not decrease as nickel augments, or, at any rate, to a negligible extent. Unfortunately, it does not seem to have occurred to the experimenters that a few samples of ordinary mild steel should have been treated in precisely the same way and used as a basis of comparison. We do not hesitate to say that not one engineer in ten thousand could say what is the percentage loss of weight by corrosion of steel in sea water, and hence save for comparison among themselves, the results given in the paper are of little value. We might go further and say that tests of the kind could never be of much industrial value—a point which was brought out by Mr. West when he referred to the fact that the rate of corrosion varied inversely as the thickness of the plate, and by Sir William White when he asked for the surface loss in place of weight loss. We may refer also to a paper by MM. Frémont and Osmond dealing with the corrosion of boiler plate, which appears in the current issue of *La Métallurgie*, and which also bears out the same point —that the rate of- corrosion depends upon the conditions aswell as the nature of the material. We mention this, as it is possible that a steel which would resist corrosion in a tranquil state might be more readily a victim to it in actual practice than one that appears less good under test. Why should not an elaborate test of corrodibility—a very important matter from the constructional engineer's point of view—form part of such inquiries as this?

Large roofs should be proportioned to carry, in addition to their own weight: *a.*—A live load, representing snow, per horizontal square foot of roof of: 15 lb. for all slopes not exceeding 35°; and 10 lb. for all slopes between 35 and 45 degrees. The possibility of a partial snow loading should also be considered. The snow load can be neglected in certain climates, also in roofs having slopes exceeding 45°, providing that there are no snow guards or other obstructions.

The weight of roof covering of different kinds per square foot of sloping surface may be assumed as follows: Corrugated steel, 3 lb.; slate on 2-in. plank, 15 lb. (add 3 lb. for each additional inch in thickness of plank); tar and gravel on 2-in. plank, 13 lb. (add 3 lb. for each additional inch in thickness of plank); tar and gravel on 3-in. concrete, 32 lb. (add 8 lb. for each additional inch in thickness of concrete); slate on 3-in. booktile, T purlins, 26 lb.

A good rule to use in calculating roof trusses of the ordinary kind is to take the snow and wind load combined at 30 lb. per sq. ft. of horizontal projection for all slopes. This will fit all ordinary cases; if the roof is flat, that load is produced by snow alone; if the slope is greater than 45°, in which case the snow load need not be considered, it is all wind, and proportionately for intermediate slopes.

In poor soil, foundation tests should always be made. In some cases, where certain kinds of soft clay or fine wet sand are met, the pressure might have to be as low as ½ ton per sq. ft.

In roofs, concrete slabs, 3 in. thick, may be used for spans up to 8 ft., and 4-in. slabs up to 12 ft. spans.

Studies in Inventive Problems—XVIII.

PROPOSED BY LEICESTER ALLEN AND SOLVED BY VARIOUS READERS.

In this number of the series I shall try to conclude the presentation of solutions of Problem VIII, but also to include a number of solutions of Problem IX, which seems to have been of interest to many readers. My own solution of Problem VIII will be presented in this article.

I shall be obliged to exclude many of the attempted solutions of this problem, because the possibility of a cut-off stroke be-

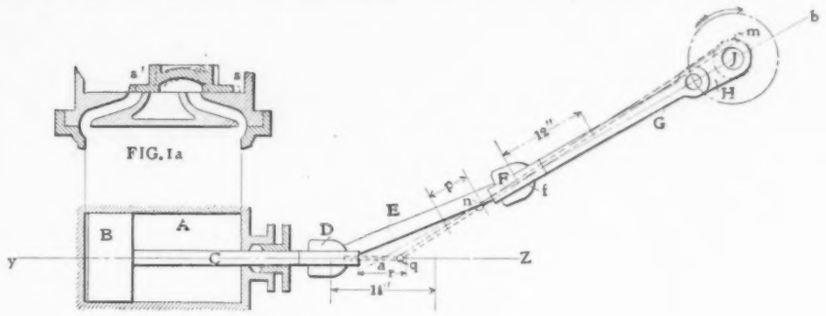


FIG. 1

SOLUTION NO. 6 TO PROBLEM VIII.

ing one of the fundamental conditions (a condition capable of substantial fulfilment with the ordinary reciprocating steam engine, wherein the axis of the crank-shaft is in line with the longitudinal axis of the steam cylinder), I consider it to be part of a legitimate solution of the problem, in cases where the center of the crank-shaft is placed out of such alinement, to show that, in the assumed positions, such a cut-off can be secured.

I mean here, of course, a cut-off at half stroke on both forward and back strokes, of the piston, as nearly exact as may be attained on the ordinary reciprocating steam engine, though we shall see before we dismiss the subject that the cut-off may be made exact and equal for both forward and return piston strokes, while, at the same time, the crank throw can be made less than the full piston stroke as required by the problem.

The first solution which is presented in this article describes a valve motion in connection with the shortening of the crank-throw. The author of the solution thinks that the cut-off required can be equalized for both strokes of the piston by making the outside lap of the valve at the two ends of the slide valve unequal, as is often done with the ordinary reciprocating steam engine. But as the position of the crank-shaft relatively to the central line of motion of the piston will exaggerate the inequality of cut-off met with in the ordinary steam engine, I think that the attempt to equalize the cut-off by making outside lap longer at one end of the valve than at the other end, would affect the steam distribution detrimentally. However, the solution reduces the stroke in accordance with the requirements, and it can be admitted that a half-stroke cut-off can be effected as described, whatever detrimental effect may be produced by the method. I must, therefore, accept the solution.

PROBLEM VIII, SOLUTION NO. 6, FIGS. 1, 1a AND 1b. J. MELANCON, AMITE, LA.

"All figures are drawn to the same scale. In Fig. 1, *A* is the cylinder, *B* the piston, *C* the piston rod, and *D* the crosshead, guided in straight line motion by ordinary guides, not shown.

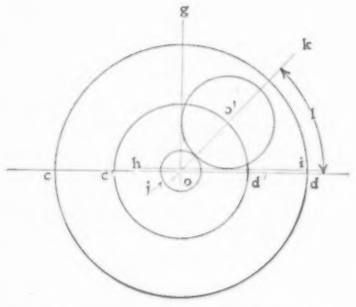


FIG. 1b. BILGRAM DIAGRAM FOR FIG. 1.

"*E* is a link, having one end articulated to *D*, and having rigidly attached to its other end a second crosshead *F*, the slide *f* of which is constrained by guides (not shown) to move only in the direction of the line *a b*. Line *a b* also passes through the center of shaft *J*. The crosshead *F* is connected to the crank *H* by means of the connecting rod *G* in the usual manner. The innovation, it will be seen, consists in the interposition of the extra link and crosshead *E* and *F*, and the raising of the crank-shaft until the angle *Z a b*, formed between the center line of the cylinder and the piston rod, and the center line of motion of the second crosshead slide *f*, is such that the known length of movement of crosshead *D* will give the desired length of movement to *f* (in this case 14:12). The lower guides for crosshead *D* should be made extra heavy to support the extra thrust from above.

"Fig. 1a shows a section view through the valve and ports, the full lines showing the position of the valve for that position of the piston shown in Fig. 1, and the dotted lines showing the valve at the end of its travel. It will be noticed that the ports are very long and the maximum port opening is only half the length of the port. The problem to be here solved may be put as follows: Given, the point of cut-off (half stroke), maximum port opening (assumed one inch), and lead (assumed $\frac{1}{16}$ inch), to find valve travel, outside lap and angle of advance. Referring to Fig. 1b; let *c d* = diameter of crank circle = 12 inches. From point *c* lay off on line *c d* the distance *c o* = that portion of the stroke to the point of cut-off = ½ stroke. From point *o* draw the perpendicular *o g*. Now draw *h i* parallel to to *c d*, and at a distance above it equal to the lead ($\frac{1}{16}$ inch), then about *o* as a center and with a radius equal to the maximum port opening (1 inch), describe the circle *j*. Find by trial a center *o'*, from which a circle can be drawn tangent to circle *j* and also to the lines of *o g* and *h i*. The radius of this circle is the required outside lap, and its center *o'* will be a point in the valve circle whose center is at *o;* this circle can now be drawn in since the radius *o o'* is known, and its diameter *c' d'* is the required valve travel. Draw the radius *o k* through *o'* and the angle *l* is the required angle of advance.

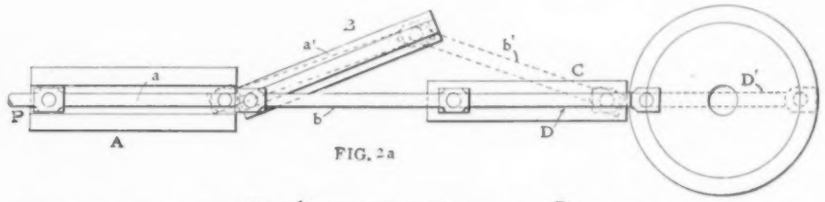


FIG. 2a

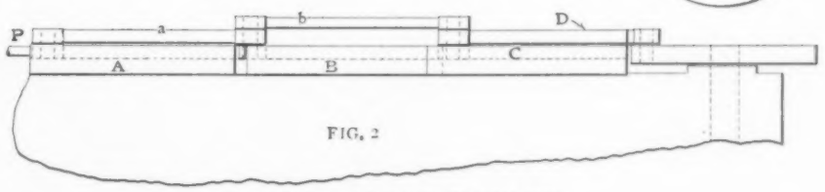


FIG. 2

SOLUTION NO. 7 TO PROBLEM VIII.

"Referring again to Fig. 1; the dotted lines show diagrammatically the lines of action of the valve-actuating mechanism. With the piston in position shown the eccentric would be the mechanical equivalent of a crank moving around *J* as a center and having the center of its pin

at *m*. The joint *n* is guided along line *a b* and has a travel = *p* = throw of eccentric, while the joint *q* is guided along line *y z* and has a travel = *r* = *c'd'* (See Fig. 1*b*) travel of valve. It is said to be understood that the steam chest and valve are on the far side of cylinder.

"Owing to the effect of the connecting rod this valve with lap, travel and other conditions as here given and computed, would cut off a trifle later than half stroke on the forward stroke and a trifle earlier

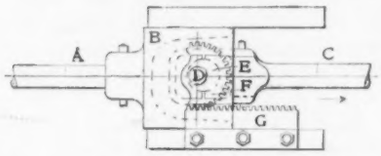


FIG. 3. SOLUTION NO. 8 TO PROBLEM VIII.

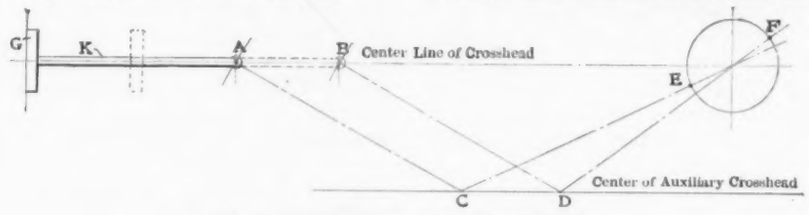


FIG. 4. SOLUTION NO. 9 TO PROBLEM VIII.

on the return. This inequality is sometimes corrected by making the outside lap on end *s* of the valve a trifle longer than on end *s'*, the amount of difference being computed by a method well known to engineers."

PROBLEM VIII, SOLUTION NO. 7, FIGS. 2 AND 2*a*. C. W. PITMAN, PHILADELPHIA.

This is a very simple solution, and as the stroke of the piston is in line with the crank-shaft, the question of cut-off needs no discussion. Steam distribution might, however, be affected.

"Links *a* and *b* are interposed between piston rod *P* and connecting rod *D*; A, *B* and *C* being guides, respectively, for the crosshead, link-joint, and head end of the connecting rod, guides *A* and *C* being in the same straight line. Guide *B*, however, is at an angle thereto, and so causes a shortening of the distance between crosshead and connecting rod as the link-joint traverses this guide, the angle being such that in the position shown in the dotted lines, the piston and crosshead having made the full stroke—14 inches—and the crank-shaft a half revolution; the connecting rod has traveled—in a straight line—but 12 inches, thus satisfying the problem."

Solutions from the contributors named below are not accepted, for the reason that the axis of the crank-shaft being out of line with the longitudinal axis of the cylinder, no provision for attaining the half-stroke cut-off is indicated or described.

Elmer G. Eberhardt, Newark, N. J., who has, however, worked out an acceptable solution presented further on.

J. Melancon, Amite, La., who uses a link motion for producing decrease of crank-throw relatively to piston stroke but in which the crank-shaft is out of line with the piston stroke, while the method of moving the valve is not shown or described.

George R. Martin, Bowden Park, England, who contributes two solutions, one of which is defective in respect of the omission to explain how the cut-off can be obtained while the crank-shaft is placed out of line with the piston stroke, the second being insufficiently explained, appearing, as presented, incapable of converting the reciprocating motion of piston into continuous rotary motion of crank.

M. E. H.

Henry Ducks, New York City.

F B. Franklin, State College, Pa.

R. R. Judd, Erie, Pa.

Harold Smith, Bradford, York, England.

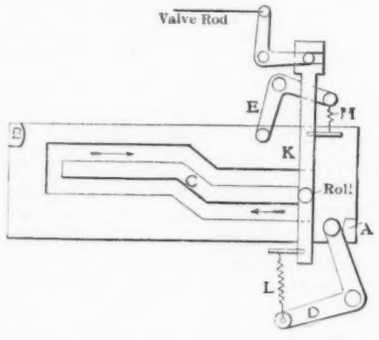


FIG. 4*a*. VALVE-GEAR MECHANISM FOR FIG. 4.

PROBLEM VIII, SOLUTION NO. 8, FIG. 3. ALAN M. BENNETT, LYNN, MASS.

This solution is open to the objection that the rack and pinion employed will be noisy in operation. Otherwise it meets all the conditions of the problem. Mr. Bennett's description follows:

"In the accompanying sketch, *A* represents the piston rod, *B* the crosshead, and *C* the connecting rod, at the beginning of forward stroke, the crank being on a dead point. To the crosshead pin *D*, which has a working fit in the crosshead, is keyed the eccentric *E*, having an offset of one inch, or throw of two inches. The end of the connecting rod embraces this eccentric, and turns on the latter instead of directly on the crosshead pin. Keyed to an extension of the pin *D* where it passes through the crosshead, is the half-gear *F* whose pitch circle equals twice the stroke of the piston. Meshing with this gear and bolted to the lower guide is the rack *G*.

"With one stroke of the piston the gear *F* is revolved through 180 deg., and with it the pin and eccentric *E*. During a stroke of the crosshead the connecting rod is thus carried backward relatively to the crosshead, an amount equal to the throw of the eccentric, or two inches, and it is evident that with a crosshead stroke of 14 inches the connecting rod will make a stroke of but 12 inches, meaning a crank-throw of 12 inches.

"During the return stroke the operations are reversed. The dead points occur at the same points on the crank circle as in the usual arrangement of crank and connecting rod, i.e., in line with the piston and connecting rods at the beginning and end of stroke."

PROBLEM VIII, SOLUTION NO. 9, FIGS. 4 AND 4*a*. M. L. MARTUS, WATERBURY, CONN.

This solution employs an auxiliary crosshead working in parallel relation with the main crosshead, the auxiliary crosshead being connected with the crank, providing valve gear shown in Fig. 4*a*. The operation of this valve gear would be somewhat more easily understood were it shown in relation with other parts of the engine; but a little study will probably enable most readers to comprehend its action. Mr. Martus supplies the following description:

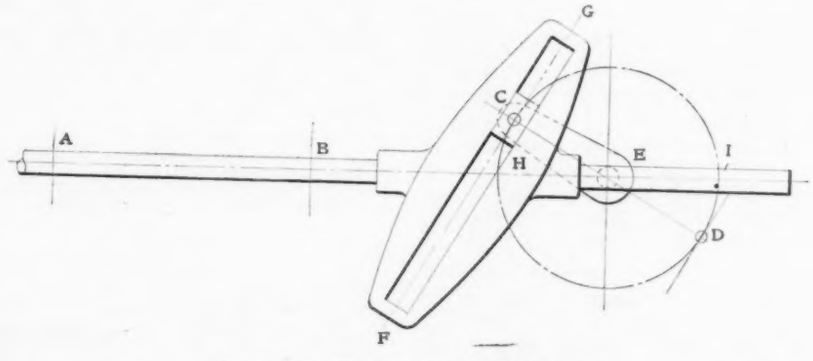


FIG. 5. SOLUTION NO. 10 TO PROBLEM VIII.

"Referring to Fig. 4, which is merely a diagram, the points *A* and *B* are the two extreme positions of the crosshead actuated by the piston *G* through the rod *K*. The points *C* and *D* are the extreme positions of an auxiliary crosshead. *A C* and *B D* are the positions of the connecting rod between the two crossheads. *C E* and *D F* are the rod positions connecting the auxiliary crosshead with the crank. The points *E* and *F* being the locations of the

crank pin at the two extremes of the stroke. The auxiliary crosshead with its guides could be placed above as well as below the piston center.

"Referring to Fig. 4*a*, which is also a diagram of the valve gear, *C* is a plate in which is a cam groove so timed that the cut-off is at half stroke. With this method the cut-off can be effected at any point of the stroke within the limits of the working angle of the cam."

"On *C* are three lugs, *A* and *B*. These lugs work rock levers *D* and *E* respectively and alternately, putting the springs *L* and *M* under tension. These springs open the valve ports by means of slide *K* and bell crank. lever *O*, with which the valve rod is connected. The plate *C* is fastened to the auxiliary crosshead, and the slide *K* is supported by the guides. With this construction the springs act only at the end of the stroke, the positive cam acting during the other parts of the stroke. Fig. 4*a* shows the spring *L* in tension at the time for admission of steam to the cylinder."

My own solution to this problem was made about twelve years ago, during the working out of a design for a refrigerating machine which has not yet been constructed. It is substantially like that of Mr. Eberhardt, which I will next present, but comprises a feature of design which I consider essential to satisfactory operation. The slotted crosshead with inclined slot is, in my opinion, the most practical solution of the problem, and it is also the simplest. It admits of an exact cut-off, the same for forward and return stroke of the piston, and is susceptible of good, durable construction, without undue friction if a properly proportioned crosshead be provided.

PROBLEM VIII, SOLUTION NO. 10, FIG 5.
ELMER G. EBERHARDT, NEWARK, N. J.

FIG. 7
Solution No. 1
to Problem IX

"Referring to Fig. 5, we have *A B* the piston rod. The piece *F G* is a modified form of the 'Scotch yoke,' placed at an angle (in this case about 31 deg.), so that a 12-inch crank circle will require a 14-inch stroke. The dead centers are at *C* and *D*, at right angles to the line *F G*, for at these points the only force which the crank pin receives is a radial one, and hence there is no turning tendency. This solution offers a practicable mechanism for an exact solution of the problem. The halves of the crank cycle are symmetrical, and also the center of the crankshaft may be located on the cylinder center line, thus leaving the valve mechanism unchanged. The eccentric would have to be located backward, by the amount of the angle *C E H*, because of the change in the location of the dead-center position. The cut-off point would be the same for both the forward and the return stroke."

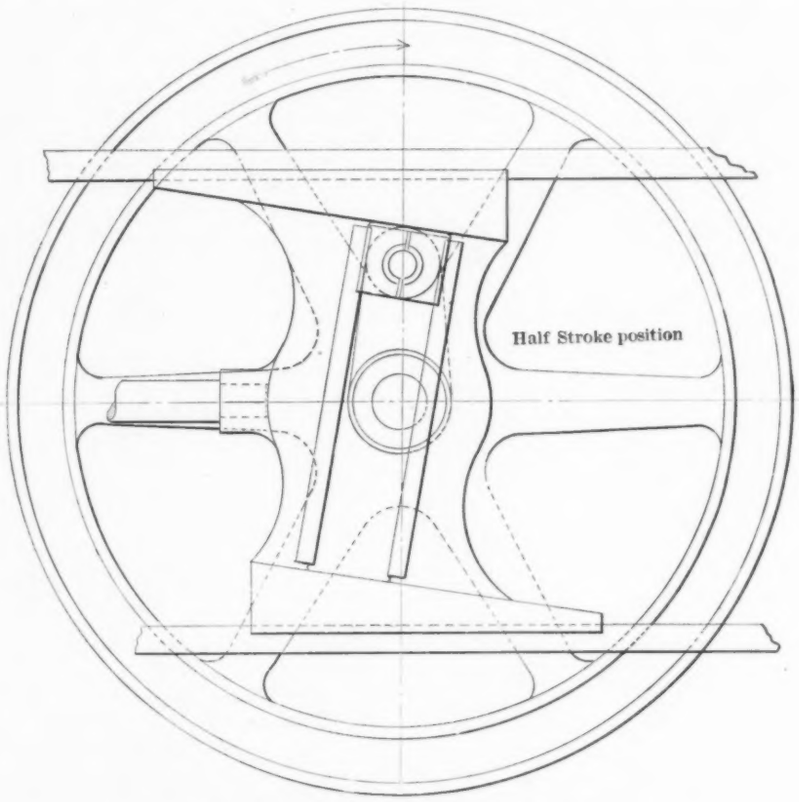


FIG. 6. SOLUTION NO. 11 TO PROBLEM VIII.

PROBLEM VIII, SOLUTION NO. 11, FIG. 6.
LEICESTER ALLEN, NEW YORK CITY.

The feature which distinguishes this solution (otherwise identical with that of Mr. Eberhardt) is the crosshead construction, which I make of Z-form, as shown in the figure, thus getting a very large bearing surface for the crosshead shoes, with minimum weight of crosshead. The guides for the crosshead join and bind the steam cylinder and compressor pump together, thus making a very rigid attachment. The crosshead consists of two parts, one on each side of a central vertical, longitudinal plane, put together with dowels and transverse bolts. No attempt has been made to show this and other details of construction; the diagram being designed merely to illustrate the principle of the solution. The figure will need no further explanation. It will be seen that this principle is capable of extension to wider differences between stroke and crank throw than that named in the problem.

The object sought in making the stroke longer than the crank throw in my design above spoken of, was to construct a slide-valve compressed-air pump with minimum end clearance in the cylinder while working the piston to as small a distance from the cylinder heads as is consistent with safety. I also designed a slotted and guided crosshead driven by a crank, thus avoiding all angularity of rods.

I shall now present the solutions of Problem IX. They are mostly so simple as not to need comment. It will be remembered that this was a go-as-you-please problem. There is greater variety in the solutions than I anticipated.

PROBLEM IX, SOLUTION NO. 1, FIG. 7,
C. W. PITMAN, PHILADELPHIA, PA.

"In this solution *S* is the driving shaft, and *a b* is the path of the center of block *B*, this path being in length and location relatively to the center of shaft *S*, as required by the problem. A gear *D* is fast on shaft *S*, meshing with an equal gear *E* on shaft *S'*, on the hub of *E* is secured crank *C*, which by means of connecting rod *R* causes block *B* to travel back and forth when shaft *S* is rotated."

PROBLEM IX, SOLUTION NO. 2, FIGS. 8 AND 8*a*. HERBERT S. GLADFELTER, COLUMBIA, MO.

"*K* is a frame supporting the shaft *S* and on which the block *R* slides. This block is held in position by the cap plate *N* and has V-grooves to slide upon. From the construction the geometrical center of

the block must move from *b* to *a* and back again during one revolution of the shaft. Connected to the block *R* and hung on the shaft *S* is the lever *M*. At the upper end of this lever the roller *P* works in the cam groove in the cam disk *T*. As the cam disk moves in the direction indicated by the arrow, the roller is forced downward and the lever slides on the shaft *S*, until *b* has come to *a*; then the reverse move-

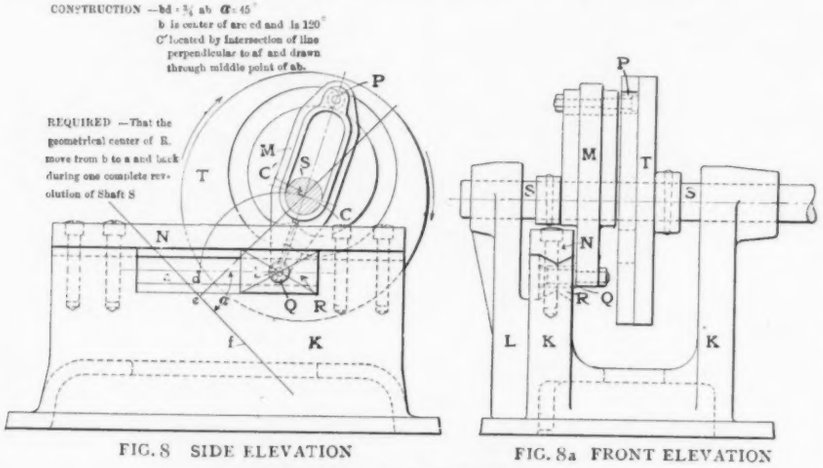


FIG. 8 SIDE ELEVATION FIG. 8a FRONT ELEVATION

SOLUTION NO. 2 TO PROBLEM IX.

ment of *b* takes place, the cam all the time moving in the direction indicated."

PROBLEM IX, SOLUTION NO. 3, FIG. 9. F. W. BACH, ILION, N. Y.

Of this solution Mr. Bach says:

"The shaft *A* drives the spur gear *B*, which in turn drives the spur gear *C*, which acting as a crank with pin at *F* with the sliding block *G*, swings the lever *D* (which is pivoted at *E*) back and forth and by aid of the sliding block *I* moves the sliding block *L*, by aid of pin *H*, as called for in the problem, back and forth, once at or during each complete turn of the shaft."

PROBLEM IX, SOLUTION NO. 4. FIG. 10. F. W. BACH, ILION, N. Y.

Of this solution Mr. Bach writes:

"As this turned out to be a quick return movement, having the quick return during the movement from *K* toward *J* when the shaft turns in the direction of the arrow, I give another one in Fig. 10, which I describe as follows: The shaft turns, and through crank *B* and connecting rod *C* moves the lever *D* back and forth, causing the block *L* to move in the path *J* to *K*, as in Fig. 9, except that the movement is of the same speed going as in coming back."

PROBLEM IX, SOLUTION NO. 5. HENRY DIECKS, NEW YORK.

In all essential particulars this solution is like that of Mr. Bach, presented in Fig. 10, and having the characteristics described by Mr. Bach.

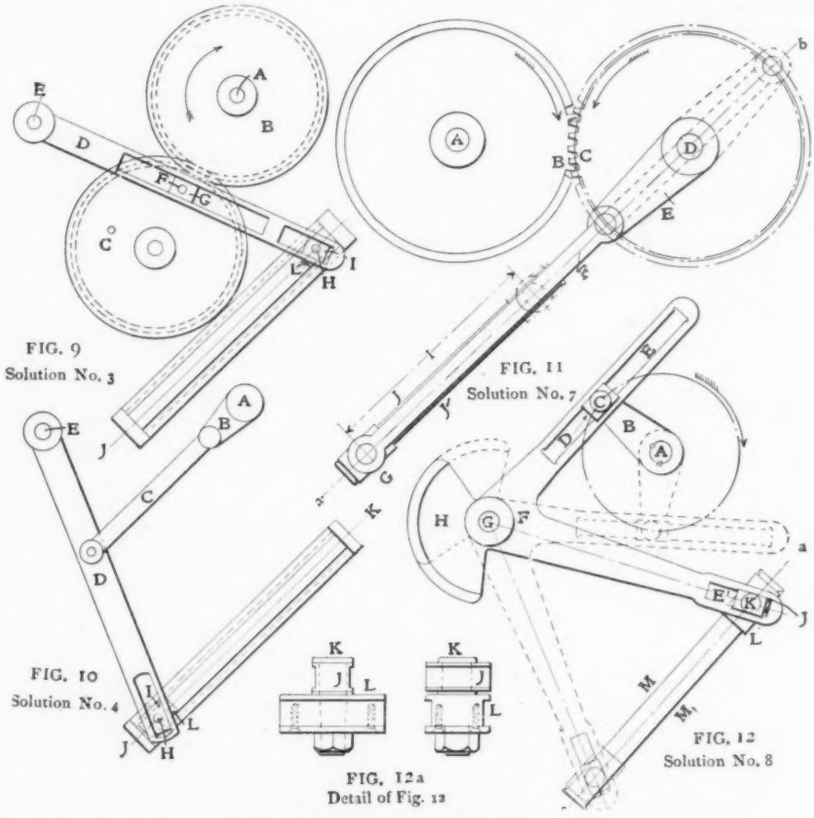
PROBLEM IX, SOLUTION NO. 6. WILLIAM WHALEY, KNOXVILLE, TENN.

This also corresponds in all essentials with the solution shown in Fig. 10.

PROBLEM IX, SOLUTION NO. 7, FIG. 11. J. MELANCON, AMITE, LA.

In this figure the line *a b* is the center line of motion of the sliding block *C*, and *l* the length of its travel.

"Shaft *A*, being located according to the terms of the problem, has keyed on it a spur gear *B*, meshing with another spur gear *C*, of equal diameter and number of



SOLUTIONS TO PROBLEM IX.

teeth, keyed to shaft *D* which is set on the center line of motion *a b* of the sliding block. A crank *E*, keyed to shaft *D*, transforms the rotary motion of shafts *A* and *D* into the straight-line reciprocating motion of sliding block *G*, by means of the connecting rod *F*. *J* and *J'* are the guides for sliding block. Dotted lines show the sliding block in position at the other end of its travel. This mechanism gives a like motion on both strokes."

PROBLEM IX, SOLUTION NO. 8, FIGS. 12 AND 12*a*. J. MELANCON, AMITE, LA.

"Fig. 12 is a plan of the mechanism and Fig. 12*a* shows to a larger scale the main sliding block, with an attached auxiliary sliding block. The shaft *A* is set with relation to the center line of motion *a-a* of the main sliding block, as required by the terms of the problem. On the end of shaft *A* is keyed a crank *B*. The crank pin *C* carries a sliding block *D*, which slides in the slotted guide-way in one arm of the bell crank *F* having its fulcrum at *G*. The other arm of the bell crank also contains a slotted guide-way *E'* in which slides the sliding block *J*, which oscillates upon a pin *K* passing through the main sliding block *L*. *M* and M_1 are the guides for the main sliding block. *H* is a counterweight to balance the weight of the bell-crank. The mode of action will be easily understood from a study of Fig. 12, in which the full lines show the positions of all parts of the mechanism when the main sliding block is at one extremity of its travel, while the dotted lines represent the positions of the moving parts when the sliding block is at the other extremity of its travel. This mechanism gives a slow motion on the out stroke with a quick return."

PROBLEM IX, SOLUTION NO. 10. H. B. MCCABE, LEWIS INSTITUTE, CHICAGO, ILL.

This solution is substantially like that of Mr. Melancon, illustrated in Fig. 11.

Letters to the Editor.

Doing Worthless Work—Gold Bricks—Modern Advertising Methods.

I've just finished reading those interesting and amusing articles by Osborne and Dixie in the AMERICAN MACHINIST, at pages 579 and 584. They brought vividly to mind these quotations from three of the most eminent specialists in human nature that I know of, Barnum, David Harum, and Abe Lincoln. Barnum said "the American people love to be humbugged," David Harum is responsible for the theory that "there's a sucker born every minute and two to catch him," while Lincoln believed that "you can fool some of the people all of the time." I think somebody also once raised this question: "Am I my brother's keeper"? There are exceptions to all rules, and the following one will bear modification at times, but in general I have found it a pretty safe guide to follow. It is this: "Obey your orders, even if you break your owners."

If you are working for a man who shows he has confidence in your judgment and evidently expects you to use it in his interest, that is one thing. If he virtually tells you to go ahead and do what he tells you without concerning yourself as to the result, that is quite another thing. Having received instructions of that kind you'd be a microcephalous idiot to bother your head over the outcome, and if you have any confidence in your own powers I'd be the last to maintain that you are not an equally unmentionable lunatic to remain in the employ of such a man.

If I went to buy a certain brand of coffee and the grocer tried to convince me some other was what I wanted it would make me feel very tired, and if he insinuated postum was what my brain was starving for, my remarks would very likely be, like Dixie's to the English bank clerk, unfit to print. But if I ask him which of his various coffees he considers best I think I am entitled to his honest and unbiased opinion, and why doesn't the same reasoning apply in the machine shop?

If a man who is in the habit of paying his bills comes into your shop and asks you to build him a perpetual motion machine that you know will be a failure, or nickel machine that you know is a fraud, is it any funeral of yours? Isn't it plenty soon enough for you to mix in when he *asks* your opinion of his perpetual failure or his nickel-plated fraud? We generally get small thanks for advice which has been asked for if it happens to differ from what is desired, so don't set up for an Adviser in General to the Universe if you know when your hat is on straight.

I've been called on a good many times to put in practical working shape ideas that I had every reason to believe would not bring their inventors a penny. If they asked my opinion in the matter they never failed to get it, and got it straight and without any excuse me's, but if they didn't seem to hanker for professional advice I never felt called upon to enlighten them, nor to air my ideas of right and wrong except in one instance.

In this one case the fellow had, with my help and suggestions, carried his experimenting to a point where he was as thoroughly convinced as I that success was impossible, but he had found an easy mark onto whom he proposed, also with my help, to unload the thing. To this day it makes me mad to think of that occurrence and I'm happy to say that individual has never since come within my range of vision. It seemed to me a little the worst insult I ever received and I'm afraid I volunteered a good deal of comment and advice that was neither asked for or desired. I'm confident I should do the same thing again in a similar case, but in general I commend to you this advice from Fra Elbertus: "To maintain order, excellence and harmony in the territory covered by one's own hat will keep one fairly well occupied."

There is, however, another phase of this matter with respect to which it is not so easy to draw a line in just the right place, to decide whether to do as you were told or as you think you should have been told. Suppose, for instance, Osborne gets an order from an old customer for a duplicate of the intermediate duphunny gear of cornsheller No. 37, model B, bored 1½ inches. Osborne knows all the gears he ever sent out on this model were bored 1 7/16 inches; that the chance of one of them having been re-bored and fitted with a larger shaft is invisibly remote; that more than one good citizen would ask for a 2-inch shaft when he wanted 1 15/16 inches; but he also knows that there is a possibility that the man is going to use this particular gear on a gambling machine and really wants it bored 1½ inches. Shall Osborne send him what he ordered, or what Osborne feels pretty confident he intended to order? No matter how he decides he is liable to be in the wrong, but if he fills the order to the letter isn't he taking the safest course?

Some of us know about how Osborne must have felt when he got that letter from the "Dispensary of Wisdom." (Garnerer of Shekels would be a better title for some of these institutions.) Beyond question these schools, or at least the best of them, have done a vast amount of good, but why need they stoop to the level of the patent medicine fakir to sell their wares? Doesn't that letter Osborne received remind you of "Pe-ruin-yer has cured others, it will cure you, no case is hopeless since this grand remedy was discovered, delays are dangerous, be sure to take advantage of our great special offer of six bottles for five dollars," and so on, ad nauseum. They should be compelled to adopt just one more detail of the nostrum vender, and that is "All mail matter sent in plain sealed envelopes." Even the best of them are guilty in this way and if that poor devil with the corrugated chalcedonic silica collarette attempts to dislodge his burden of ignorance his mail matter will herald forth the fact that he is, in middle life, just learning some of the things his more fortunate fellows acquired in their early teens. That's nothing for him to be ashamed of, of course it is highly creditable, but some of us are so sensitive we don't like to have even our good deeds shouted from the house tops.

It is about as Osborne says: If one could contrive to do without rest or recreation, eating or sleeping, and was so young that no idea had been formed as to what a very ordinary fellow's real capacity is, one might be able to reach the goal these institutions so invitingly hold out. They never mention the fact that most of our notably successful men have been men who were mentally, or physically, or both, strong beyond the average. Strength and endurance are the two first requisites to success. Unless we have the stamina to "keep everlastingly at it" we may as well be content with a rung of the ladder that is more or less removed from the top. All of which reminds me of some advice I once extracted from a physical culture magazine, which was: "Never sit when you can stand, never stand when you can be walking." Now wouldn't that be excellent and highly desirable in the case of a poor hod carrier, or a letter carrier, who was wearing a porous plaster across the small of his back in a vain endeavor to bear up under more laborious duties than nature had fitted him for? Is it any more absurd than to claim that a fellow is sure of success if he only studies so many hours per day, regardless of whether nature has given him the strength to stand the strain of confinement indoors during those hours he has been accustomed to spend in rest and recreation?

I'll bet a big cooky with two currants on top of it those chaps who advise this don't suffer for lack of recreation, and it is the dollars of over ambitious young fellows who work hard for their money that they spend in a good many cases. When they go so far as to offer you special inducements to reduce yourself to a physical wreck in an endeavor to become a success (?) you can be pretty certain there is a gold brick not far away, and one with gilding so thin and brassy that a very ordinary fellow indeed should be able to detect it.

Let me tell you a little story about a success of this sort that I saw not a great while ago. There was to be a concert at the local opera house, exploiting a certain famous piano. The papers were full of flattering notices the critics had

written as to the marvelous performances of the young woman who was to be the soloist of the evening. Though a mere slip of a girl they compared her not unfavorably with the great Paderewski himself. After preludal efforts by minor stars the house became very quiet, for the phenomenon was about to appear. A poor little sickly looking girl who walked as if she wanted to support herself by the furniture came on the stage. When she sat down to the big concert grand it was to sit "all in a heap." As a woman, such a woman as her Maker intended her to have been, she was, to all appearances, a most deplorable failure, but as an exponent of the divine art of music she was the biggest success in her special line that I ever had the pleasure of listening to. I forbear to comment, you can draw your own conclusions as to whether her success was real and of a sort you would like to win for yourself.

When I was young and ambitious myself I admired and emulated those nervous fellows who seemed to have the fate of nations hanging on their hands; but now, if there is anyone whom I really envy, it is the deliberate individual who sits for hours at a time holding a fishpole over an unpromising pool with never a sign of a bored expression on his countenance or of ennui in his soul. He will still be serenely fishing from his mossy log when I am before my Maker trying to account for my shortcomings, not the least of which I count my inability to be absolutely happy at doing nothing.

There are times when the very best thing a man can do is to loaf and invite his soul, and let me tell you that sort of loafing is a fine art, not at all easy to acquire. Osborne may think he loafs once in a while, but it is apples to oranges that even in his most idle moments he has one ear cocked to windward to catch some new echo from the Oil Country, and may he long be spared to harken for these agreeable sounds. I'd like nothing better than to explore that enchanted country with him and help him perfect several sorts of exterminators, for, like the fellow in the Mikado, "I have got a little list of society inflictions that might well be under ground, as they never would be missed, as they never would be missed."

Lest Osborne form too good an opinion of my attainments I'll have to admit that in spite of best efforts to the contrary I never could manage to loaf with comfort and satisfaction without the help of the bicycle, kodak, piano, or some other modern invention that should be superfluous. This is one of my numerous faults that I am actually ashamed of.

I'm not holding him up as a sample of success, or as a model for young men to copy, but that fellow fishing on the old mossy log never felt the need of any of these complicated adjuncts to the gentle art of loafing, never knew he had optic nerves, or an appendix, or a stomach unless it happened to be unpleasantly vacant, and for the blissfulness of his ignorance I profoundly envy him.

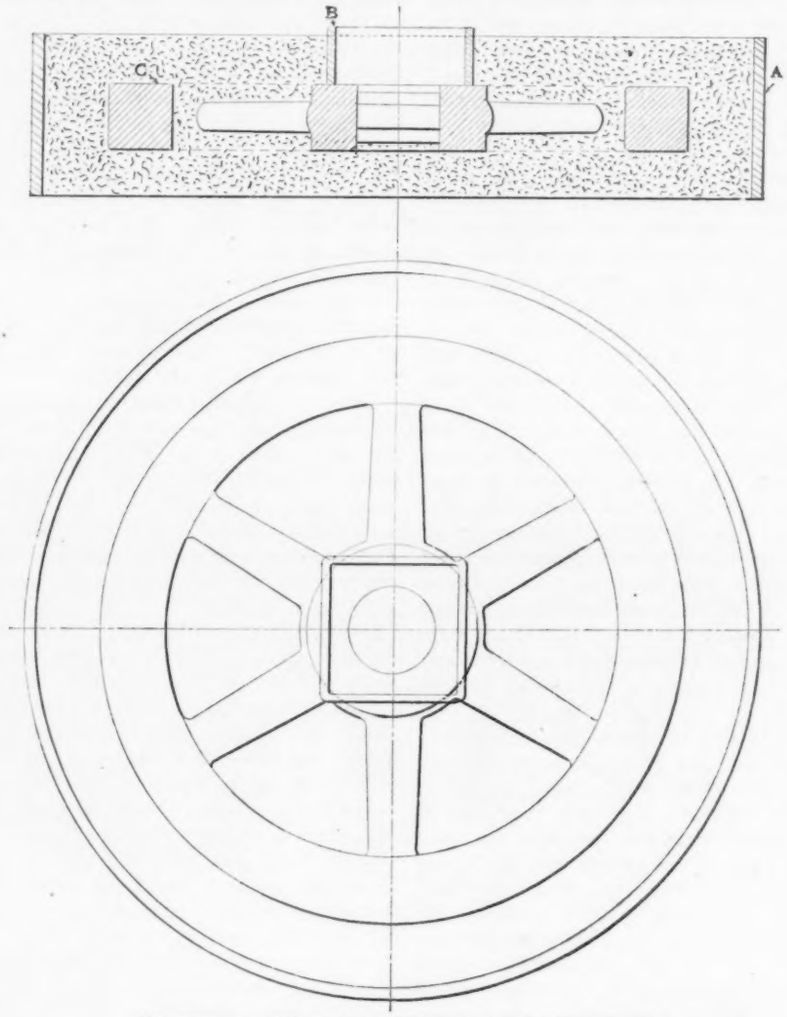
E. R. PLAISTED.

Minimizing Shrinkage Stresses in Balance Wheels.

Balance wheels when built with solid rim and hub usually give considerable trouble to foundrymen on account of the arms pulling away from the rim while the wheels are cooling. This is due to the smaller cross-section of metal in the arms cooling much more rapidly than the large area of metal in the rim and hub. A common method in vogue is to strip the green sand from the rim and hub, and heap it over the arms. It is endeavored by this means to promote a uniform reduction in temperature throughout the whole mass.

The writer's experience with this method has shown it to be entirely unreliable, and exceedingly dangerous. He has seen wheels treated in this manner that have left the foundry in apparently sound condition, and while standing on the machine shop floor they have parted across the arms, leaving a crack an eighth of an inch wide, showing an enormous initial stress in the arms. He has also seen them break while being tested on the engine. It is quite obvious that wheels under such initial stresses are very dangerous to put on the market.

To properly cool balance wheels of this class the arms should always be kept at the same temperature as the rim and hub, while the whole mass is slowly cooling. If such a condition is maintained, the final shrinkage stresses in the wheel will be a minimum, but the magnitude of these stresses cannot be ascertained.



MINIMIZING SHRINKAGE STRESSES IN BALANCE WHEELS.

The following method to produce these results was adopted by the writer. After the wheel has sufficiently cooled to be properly handled by a crane (this is about red heat) it is placed upon a bed of dry core sand from the chipper's floor, and is completely covered with the same material, with the exception of the hub. The core in the hub is removed, and a small flask put around the hole to prevent the core-sand from filling the hole. There should be from 8 inches to 10 inches of sand completely surounding and covering the wheel to properly insulate all portions with the exception of the surface of the hole. It will be readily seen that all the heat in

the rim must pass through the arms and hub before it can be radiated, and thus the temperature of the entire mass is gradually reduced to that of the atmosphere. The writer has treated a number of wheels in this manner, and not one has been known to fail.

The sketch illustrates this method of cooling. *A* is a cast-iron ring at least 16 inches larger than the wheel *C*, and prevents the dry sand from falling away from the rim. *B* is a flask placed over the hub. A 72-inch diameter wheel with an 8-inch square section of rim will take about 72 hours to cool to the temperature of the atmosphere.

G. F. MADDOCK.

A New Flask.

Here is a foundry flask, 10 inches by 18 inches, designed for bench or machine work. It was built in an experimental way with the idea of producing a light flask with all the advantages of the cast-iron flask, and combining strength with lightness. Copes and nowels are identical and interchangeable, that is, any two parts may be used together, and are easily knocked down to be stored in small space. Different lengths of sides may be used with the same ends, and *vice versa*.

The core and nowel weigh 16 pounds each, or 32 pounds for the whole flask. A wood flask of like dimensions was found to weigh 20 pounds total, while a cast-iron flask of the same size weighed 48 pounds.

The sides of the flask are of heavy galvanized steel, bent at 90-deg. angles on about 1-inch pitch, and hemmed over on the exposed edges; they were bent upon an ordinary brake, as used by sheet-metal workers, but could probably be rolled or stamped with less expense in quantities. The ends are of cast-iron ¼ inch thick, with lips upon the inside edges to secure the sand. Wrought-iron handles are cast in, their center lines being on a level with the top surfaces of the pin plates.

Detachable pins are provided and all flasks are fitted to one pair of pins. A locking device is arranged, as shown in Fig. 1. The pins are of steel made in a turret lathe. The pin proper is ¾ inch diameter with a cylindrical head, 1⅛ inches diameter by ¾ inch high. A small lug is cast on to the flask end, over the pin-plate and projecting far enough to clear the ¾-inch pin. One side of the head is milled off flush with the body of the pin to allow the head to pass by the lug. The top of the head is filed for a slight cam lead so that turning the pin either direction by a ¼-inch round lever, which is driven into the head, will lock the pin in place. When the lever is perpendicular to the flask end, the pin can be extracted.

The gray-iron ends are corrugated to fit the sides as are also the bolt straps upon the outside. The latter have two ⅜-inch studs cast into them, spaced to match the holes in the flask ends. (See F, Fig. 3.) These holes are slotted to the edge of the flange so that the flask ends can be removed by loosening the nuts without necessitating removal of the bolt straps.

As far as used, this flask has proved very satisfactory. Aside from its lightness its carrying quality for sand is an attractive feature, especially for stripping-plate work. The danger of run-out is remote as perfect contact of cope and nowel is insured. Contact is upon four filing spots, one at each corner, 1/16 inch high. These are filed to a surface plate so that all fit each other.

Figure 2 shows the application to wood sides of this style of end and bolt straps. This makes an economical flask. A new flask can be easily and quickly built from old ends, thus many lengths of flasks may be kept on hand in small storage space. Flask-bars are of cast iron, flanged and slotted similar to the ends and held in place by bolt straps in like manner.

We have found that a convenient method of casting these ends is to make cores containing the handles and pin plates. *A*, Fig. 3, shows two parts of such a core before pasting together and with wrought handle in place. *B* and *C* are the two core boxes. A small lug for the clamping device is observed in *B*. This is pulled through the side of the core box after the core is rammed.

To insure a uniform shape of handle a forming block of gray iron is provided for the blacksmith. *D*, Fig. 3, is the pattern for it. Fig. 4 shows the block in place upon the anvil and a piece of ½-inch round iron partly bent around. The iron rod, after heating, is inserted in

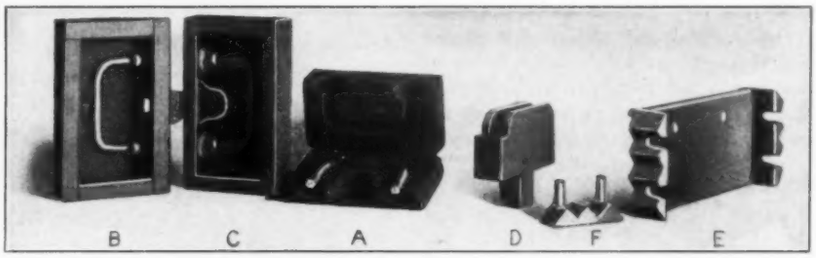


FIG. 3. CORE AND HANDLE, CORE BOX, PATTERN FOR FORMING-BLOCK, BOLT STRAP, AND END OF FLASK.

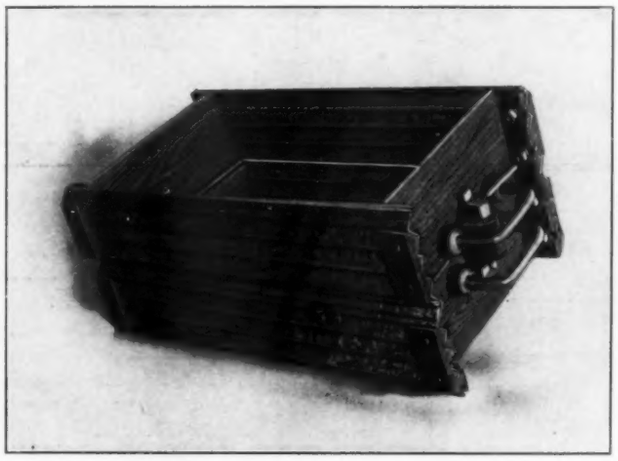


FIG. 1. A LIGHT METAL FLASK.

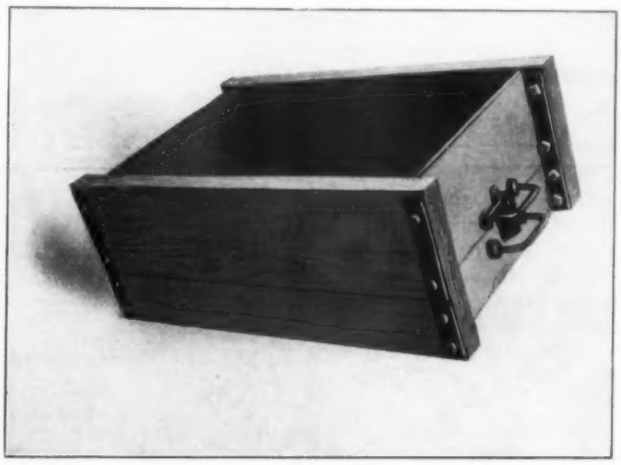


FIG. 2. COMPOSITE METAL AND WOOD FLASK.

FIG. 4. FORMING THE HANDLE.

the hole in the block at *A* as far as the face of the anvil, then bent around the block and cut off at *B*, this end overhanging the anvil. The process is rapid and is accomplished without hammering. A stock of handles can be easily kept on hand with little expense.

The pattern *E*, Fig. 3, has no print for the core, but a red spot is painted upon the pattern on which to locate the core. In molding the end, the core is placed upon the red spot before the nowel is rammed. When the nowel is rolled over, the core taken off and pattern drawn, the core is more securely placed than though a core print had been used. A stock of these cores can be kept on hand to draw from since the same arrangement is used upon all flasks unless double handles are required, then the pin-plate and small lug are placed, and it is cast in green sand.

A jig is maintained for each length of flask, this consisting merely of a piece of flat iron with two holes drilled at the proper space for pin holes. Each part of the flask is put together upon the jig to insure their being interchangeable.

We are yet to be convinced that a rough cast flask pin and hole are practicable.

WILBER R. TILDEN.

Worcester Polytechnic Institute.

Tempering and Lubricating Reamers

The inherent depravity of the taper fluted reamer is so well known that special mention is not needed. Its tricks and vagaries are sought to be overcome by all sorts of expedients. It chokes and jerks out a piece of itself, or it refuses to cut, or it chatters, or sticks fast. Engine oil does no good, and lard oil is substituted, still it doesn't behave well. It is ground to a different angle, or it is made with an odd number of flutes, or they are irregularly spaced, and after all it is about as bad as ever. Sometimes they are fluted spirally with indifferent result. It will either feed itself too fast, or it will require force to make it cut, and all that.

The "slickest" lubricant I have ever used and the one that cures all the ills that reamers are heir to is tallow and flake graphite thoroughly mixed. It is a sensuous delight to use a good reamer thus lubricated. Any old, out of round, hand ground reamer works smoothly, and one wonders why someone didn't say so before.

Speaking of reamers, it is in order to say the only way to harden a long reamer without warping is to suspend the reamer and tongs by a string twisted tight and when the reamer is heated properly, hold it over the tub suspended perpendicularly by the string in one hand, holding it from turning with the other. When you are all ready let go and allow it to revolve rapidly and dip at the same instant. Reamers or taps or any tool hardened this way will be practically straight. This is a new trick and a good one.

C. W. CRAWFORD.

Machine Molding a Spring Shoe Casting.

Fig. 1 shows a spring shoe for a railway wagon. Eight of these pieces are required for each wagon. The method of molding these pieces on the stripping plate machine is simple and inexpensive, and the enormous increase in the quantity made per day over ordinary hand molding makes it difficult for firms not using machines to compete in this rather closely cut line.

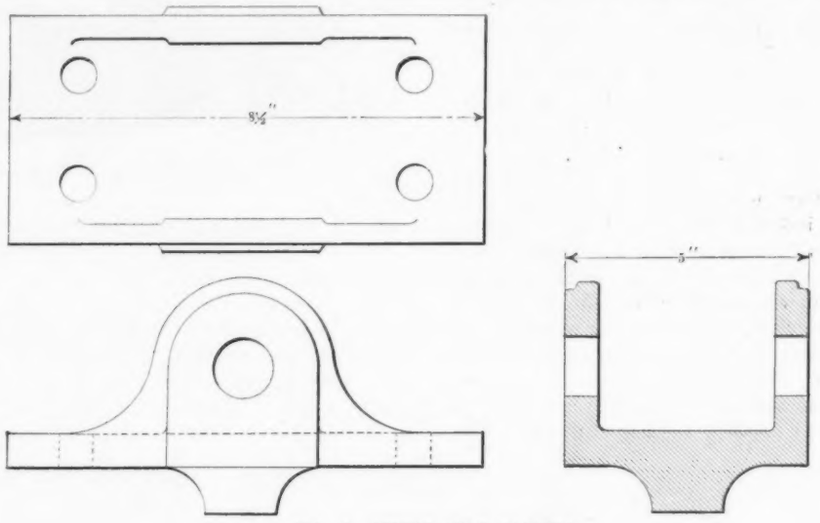


FIG. 1. SPRING SHOE CASTING.

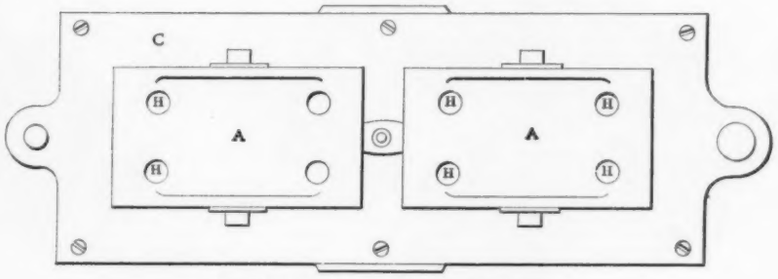


Fig. 2 Plan of Molding Machine Head and Patterns

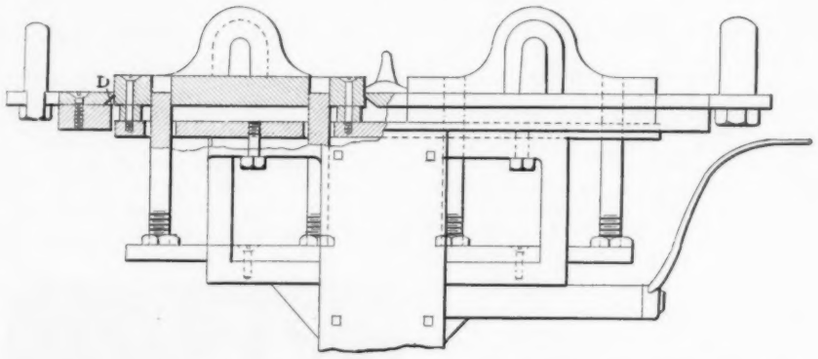


FIG. 3. ELEVATION OF MACHINE PARTLY IN SECTION.

Fig. 2 is a plan and Fig. 3 a front view of a molding machine head on which are mounted two spring shoe patterns. The principal and generally the most expensive item in the fixing of patterns on the machine is the stripping plate. Many plates are, however, quickly and cheaply made, and the plate made for the spring shoe patterns is obtained with little trouble by having a core box made just the size of the hole required for the pattern to pass through, and the same thickness as the stripping plate. In the plan, Fig. 2, *C* is the stripping plate and *AA* the two patterns, the openings for *AA* being made in the plate by the cores (which are laid in a mold made from a plain plate) in the position desired. The edges of the openings in the plate are kept a little full to allow of filing to a true fit, but if care is taken very little fitting is required. The bottom inside edges of the opening are backed away as at *D*, Fig. 3.

The eight holes *H*, Fig. 2, are stooled and the green cores required no nails when molding to keep them attached to their respective positions in the mold.

A plate pattern is used to form the drag or bottom face of the mold, a section of

the drag plate being shown in Fig. 4. This plate is bedded in the floor on a prepared bed of facing sand and knocked down with a mallet; the two pins *PP* are then driven into their respective holes and the plate pattern rapped and drawn off. The cope is located by the pins *PP*, and after setting the cope these pins are pulled out and used again. Two or three sets of pins are required, so that there is no waiting when the molds are being made, it being usual to have two hands working, one on the cope and the other on the drag.

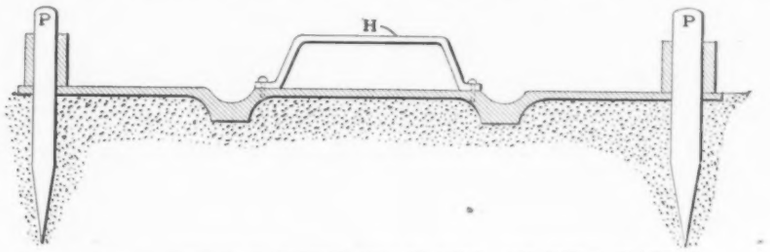


FIG. 4. SECTION OF BOTTOM PART OF MOLD, AND NOWEL PLATE.

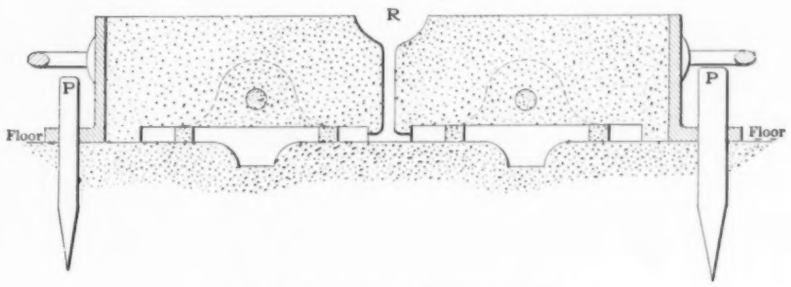


FIG. 5. SECTION OF MOLD COMPLETE.

The reason why no box part is used for the drag is that a set of flasks were found which were made for other special castings. The cope part was used as described for the spring shoe, but the drag being unsuitable for this piece the plate was used in preference to making new box parts. Fig. 5 is a section of a mold complete and ready for pouring.

GEORGE BUCHANAN.

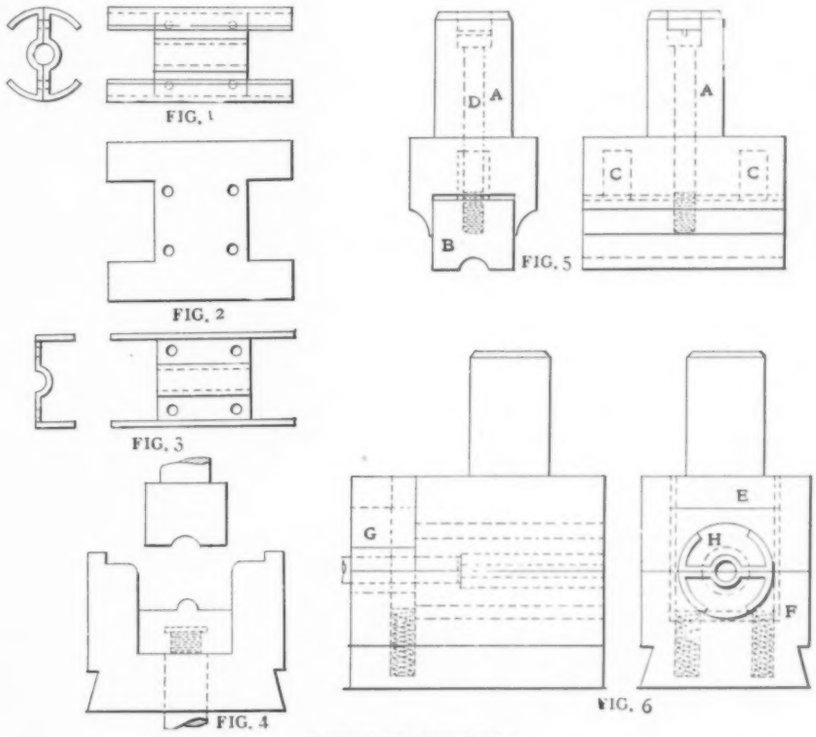
North Wales, Great Britain.

Press Tools for Forming Small Armature Bodies.

The sketches show a set of tools for making armature bodies as used in telephones for ringing up.

Fig. 1 is the article as it comes from the tools minus the spindle, which is forced in the center hole; ordinary ⅜ iron, bright drawn, is used for that. Two holes are drilled through and pins are driven in tight to keep the affair together. The spindle ends are turned down to fit the boxes. The material used is the best charcoal or Swedish iron. The blanking tools I have not shown, but Fig. 2 gives the shape of the blank and shows the four rivet holes. There are, of course, two blanks to each armature and these are produced with ordinary piercing and blanking tools.

The next or second operation is bending to the shape in Fig. 3, which work is partly done with the tools shown in Fig. 4. It will be noticed that the corners are sharp. As it is impossible to make them so in an ordinary bending process, operation No. 3 is necessary. The same die is used as in the previous operation, but another punch, Fig. 5, is required. This punch brings the corners up sharp, so that when the two parts are riveted together they form a close joint. After the riveting operation is performed the work is ready for the finishing operation, which is accomplished with the tools in Fig. 6, which shape the armature as shown in Fig. 1.



THE WORK AND TOOLS.

The tools are made of cast steel throughout, hardened and tempered to a very dark straw, so as to leave them hard and tough. The bending tool, Fig. 4, is made as in the sketch with a set edge for the blank to rest in, shaped out to the required width with a plate in the bottom threaded to take the knock-out rod. The punch is formed with a shank to fit the press and made two thicknesses of the metal narrower than the die.

The punch in Fig. 5 has a shank *A* to fit the press, is slotted out to suit the rod *B*, also recessed to take the two rubber plugs *C C*, which act as springs to keep the rod on the bottom of the work while it is pressing the metal in the corners. The rod is held up by the screw *D*.

The finishing tools, Fig. 6, consist of the punch *E* and die *F*, bored out to the diameter of the armature. As in the sketch the back part of the die projects up at right angles and is dovetailed to suit slide *G*, which carries the mandrel or former *H*, which is driven tightly in the slide and kept up by the two spiral springs so that the work can be put on when clear of the die. When the punch and die meet they form a circle the exact diameter required. The mandrel is bored and slotted out the required shape, so that the armature can be pushed on from the front. The rod is to knock the work out in case it should stick, due to variation in the thickness of the material.

London, England. C. PETITJEAN.

A Setting Attachment for Draftsmen's Protractor.

Those of us who have used the B. & S. protractor know what a convenient tool it is. We also know that it is so fitted up that it is quite stiff, this being so in order to prevent the possibility of moving when once set. If there are no means provided for locking the moving portions to the outside parts, it is of course necessary to have a good snug fit, the objection to this being that it is quite difficult to set the protractor very exactly. Whatever is done, there must be no projecting parts, so that it will be possible to reverse the tool, and allow it to lie flat on the paper when in the reversed position; I hit upon the following plan which I think meets these conditions: A segment of a gear is let in flush in the portion of the moving arc which is not graduated, and held by four rivets, all flush; and on the stationary part a seat is counterbored and provided with a hardened bushing, which is pressed snugly into place. A neatly fitting key such as used on the Jacobson drill chuck, but with a nurled knob, is provided, having a pilot which enters the hole, and the pinion of which meshes with the segmental gear. The pitch of the teeth should not be greater than 48.

ROBERT A. LACHMANN.

Turning and Boring on the Miller.

One day, when all the lathes in the shop were busy, we received brass castings for five vacuum pump cylinders which were required immediately or sooner. A miller was the only idle tool in the shop with which it was possible to do the job, so that was seized upon and put to work in the following manner:

First the feet e'e" were finished to size with an end mill. Then the five castings were strung along the platen and the seat for the head *E* faced off with the same tool. A chuck replaced the end mill, and with the boring bar *F* held in the chuck all were roughed out with one setting of the tool. The tool was then sharpened for a smooth cut and all finished in the same manner, thus making the bore of the cylinders of a size within close limits. The counterbore *H* next received attention. This was for the disk *D* to close the hole which the draftsman evidently thought necessary to support the core. The turning tool *C* replaced the boring tool *B* and the one-inch nozzle *I* was turned on all at one setting of the tool, the cylinders being held successively in the vise. The tool *A* placed in the boring bar cut five disks out of ⅛-inch sheet brass to fit the counterbore *H*. We were now ready for the head *E*.

The chuck gripped the boss and a twist drill, boring tool and facing tool held successively in the vise performed the different operations fitting the flanges to the cylinders, to which they were held by four screws. As the job was done two or three years ago, I have forgotten the actual time, but it was fast, and it first excited the derision and then amazement of the orthodox who watched it progress. I have heard the lathe called the king of tools, but I believe the miller can successfully dispute the distinction. A greater variety of work can be more conveniently done by that tool than any other in existence.

I find I have sketched the boring bar too large in diameter. I mention this now, to avoid any such embarrassing questions as had Dixie "up a tree," with his three fluted taps, for I doubt if I would be able to come down with as much elegance and grace.

WM. DEATS.

Yonkers, N. Y.

An Answer to Apprentice.

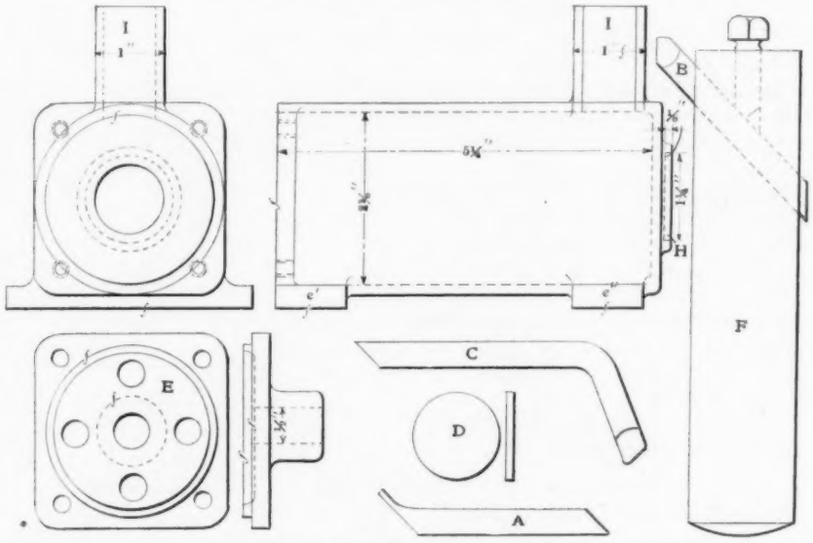
In reading the article at page 455 signed Apprentice, I thought that possibly this apprentice and others might like to hear from one of the old school.

He speaks of being in a position to see and judge from the apprentice's standpoint, and of having the best opportunity, etc., but is he seeing, and making the most of these opportunities, as they are presented? Machinists' work, combined with a little theoretical education, which is easily obtained, should make an interesting subject for any young man, and worthy of his best efforts. The more he studies theory, the easier will become his practical work, and as they go hand in hand and are so helpful to each other, a young man deficient in either, works under a handicap.

In regard to filing and the file, when he says that it is a lost art, he at least has never lost it, and when he has become proficient in that lost art, he will recognize the fact that a good file, in the hands of a mechanic, is a powerful weapon toward reducing a piece of work to its commercial value. I will admit that in modern machine-shop practice, filing has been eliminated to the minimum, but when he has graduated into the ranks of the tool and die makers, he will find that the man that can handle a file is the man they are looking for.

In the four weeks' time that he put in on the drill-press, drilling with those jigs, did he stop to think that some toolmaker must have given up considerable of his valuable time in designing and making those despised jigs, and after handling them for four weeks, did he not acquire some valuable knowledge in the designing of jigs, their construction, and use? Did he not try to think how the principles embodied in those jigs could be applied to other jobs of drilling that were lying near at hand, how he could have improved some of them? Did he take notice of the construction of the drill-press itself, note the feed and speed changing devices, the drill chucks, tapping attachment, reversing mechanism, etc., and store it all away for future use?

If he did these things, he may rest assured that the four weeks on the drill were profitably spent, and that he has added materially to his mechanical knowledge.



TURNING AND BORING ON THE MILLER.

The point that I wish to bring out in this article, is that an apprentice, having started at work and made up his mind to learn the trade, cannot be denied the same, as it is up to him whether he learns it or not. If he applies himself, tries to do his work well, is always ready when asked for a lift, and keeps both eyes open looking for knowledge, he will, at the expiration of his four years' apprenticeship, have a good fair idea of what will be expected of him, in the 30 or 40 years' shop practice to follow. On the other hand, if he slinks through his apprenticeship, bemoaning his fate, seeing nothing but the shop clock, and the expira-

tion of his four years' apprenticeship, he will find upon entering his first outside shop, that he is not a machinist, but a poor excuse for one, and will have to open his eyes, get busy, or get fired.

The apprentice should not get excited over the handy-man at 16c. per hour, because he is a permanent fixture at that price, but remember that he is an "unknown quantity" to his foreman, until he displays some mechanical ability, such as will warrant him in giving him a change of work, and a raise.

He must look upon his four years' apprenticeship as a school of instruction, minus a teacher, with the text-books all made up into the men and machinery about him; every piece of rough stock an unsolved problem waiting to be solved, and the solved problems are the finished work on the rack, after being solved by these transformed text-books.

If he carried the stock to the machines, the finished work to the racks, and saw nothing more, he is like the boy that took his school-book home to study, only to carry it back on the morrow unstudied. On the other hand, if he will watch these problems that are being solved every day, note the varing operations, the methods employed by different men, and ask a few questions now and then, he will find that this will be his real instructor, and the trade is there, his for the taking.

I have no recollection of anyone taking me kindly by the hand, when I served my apprenticeship and saying, "Jack, I am about to lay out a difficult piece of work, and as you are the apprentice, I have placed an easy chair near by, and if you will accompany me,

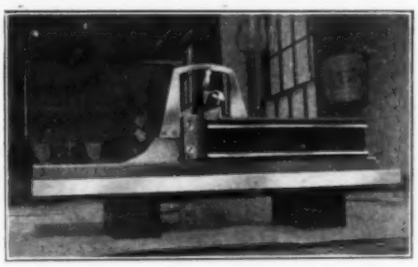


FIG. 5. SPECIAL BENCH GAGE.

I will show you all about laying out work, from A to zero." Oh, no, but I have heard the foreman say, "Jack, give Bill a lift over there, take a bar with you, and be quick about it." If I got any instruction in laying out work, it was over Bill's shoulder, and by asking questions.

If an apprentice wishes to become a favorite with the head men, he should be on hand every morning before the whistle blows, as this alone will cause a stir in commercial circles. If he has marked mechanical ability, and resources, lets his light so shine that the foreman will notice it first, it will eventually reach the manager's desk, and be recognized.

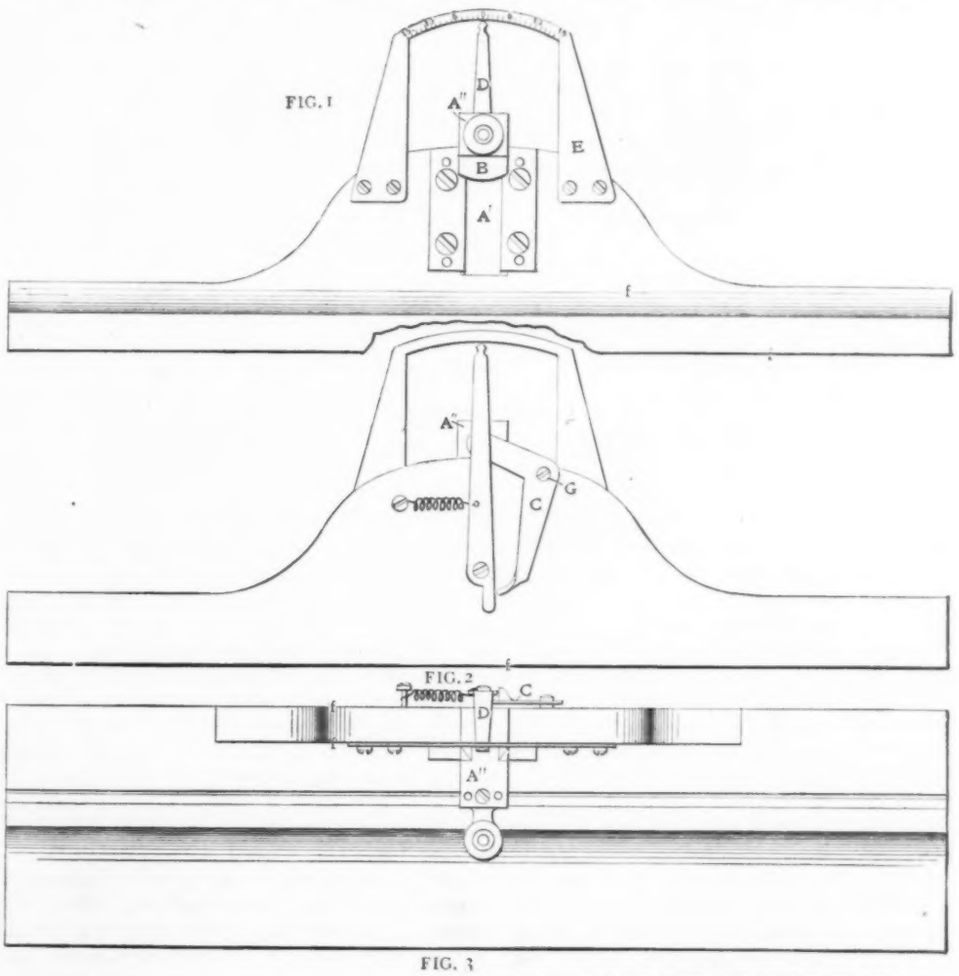
J. C. GRAHAM.

A Special Bench Gage.

There is quite a lot of work connected with the construction of a good dental chair. Some time last year I was hired to take charge of the tool-room of a plant building nothing but dental chairs. For years they had gone along without any regular tool-room, making their tools and fixtures from hand to mouth as it were.

To all who may contemplate engaging in the dental-chair business, I would say go slow. Not that the tools required are or have to be elaborate or difficult of construction, but improvements and changes are constantly being made, and the jigs and fixtures have to be made with a view to future changes in the design of the chair.

Besides the regular tool work, we have to carry on all the experimental work, and get out all the patterns for it. As every shop has its individuality, I am going to



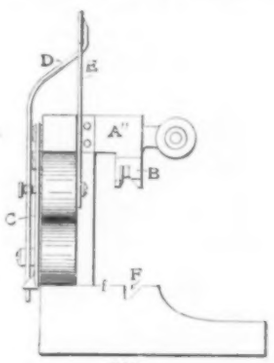


FIG. 4

FIG. 3

BENCH GAGE FOR BACK SLIDES OF DENTAL CHAIRS.

describe some of our tools with which we hope to improve our output. The first will be a bench gage for determining the variation, if any, of a slide. On account of the beveled edges, a pair of calipers or "mikes" cannot be used to measure this slide. The base of the gage is made of gray iron planed as shown at *F* Fig. 4. The front view is shown at Fig. 1. *A'* and *A"* are composed of two pieces dovetailed together at right angles, both pieces working as a unit, and have a vertical motion. On the front end of *A"* is fastened a piece of tool-steel *B*, this piece is turned and then cut to the form shown. The function of this sliding piece is to permit the slide to be gaged, to be slid under the rounded piece *B*. As this part of the gage is forced upward, it imparts its movement to the bell crank *C*. *C* is pivoted at *G* Fig. 2, and the hole for the screw that holds *C* to *A"* is slotted horizontally, thus allowing *C* to have freedom of movement when *A"* is moved. *D* is the indicator hinged at its lower extremity. The spring tension forces the piece *A"* downward. By referring to Fig. 3, it will be seen how the gibs are arranged to retain *A"* in a vertical position.

In action this gage is semi-automatic, since by the pushing of a slide under the contact piece *B*, the pointer registers automatically whether the slide is small or large or just right. The arched piece *E* is graduated to thousandths. Fig. 5 shows the gage with a slide in it.

CARROLL ASHLEY.

Molding a Sheave Without a Pattern.

In the case of a hurry-up job, or if one casting or so is to be made, it will be economy to make it in the method described herein. We have made several, and find that it pays; when a job comes into the foundry they always want it *yesterday*. We will suppose that this is a sheave, five feet in diameter; those that we have been making are webbed with arms or ribs on them. Get two sets of hubs with these ribs attached to them, and with holes through them to slide over the spindle, and two sweeps, one to sweep the bottom and one for the cope. Now dig out the hole, put in the spindle step, and a coke bed, and ram up to within 6 inches of the floor line; then bed in one set of the hub and arms, put on the top sweep, leaving the required thickness between the arms and the sweep for the web. Ram this up and make your joint for the cope, now put on the set of arms and hub and ram up the cope. Lift off and finish the cope, then take away the sand that was between the two hubs and ribs; vent it well, then put back the bottom sweep and finish. The latter has the print on it that forms the place for the groove cores on the outside.

I would not advocate the process for a standard job, but for a few castings it is all right; a man with a helper will make one in a day that will weigh from 10 to 15 hundred.

THOS. WATHEY.

Cleveland, Ohio.

Some Press Tools and a Polishing Disk.

I worked for a firm at one time that made some small dies as shown in Fig. 1. These dies were used in small power and hand machines for closing in wire stitches for button shoes and the like, and were finished by tools which had never been improved upon since they were first designed. Time seemed to be a trifling factor in that section of the shop. Finally, in estimating the cost of the various parts of the machines, these dies were found to be a costly item for their size, and the foreman was instructed to improve on the manner of finishing so as to reduce this expense.

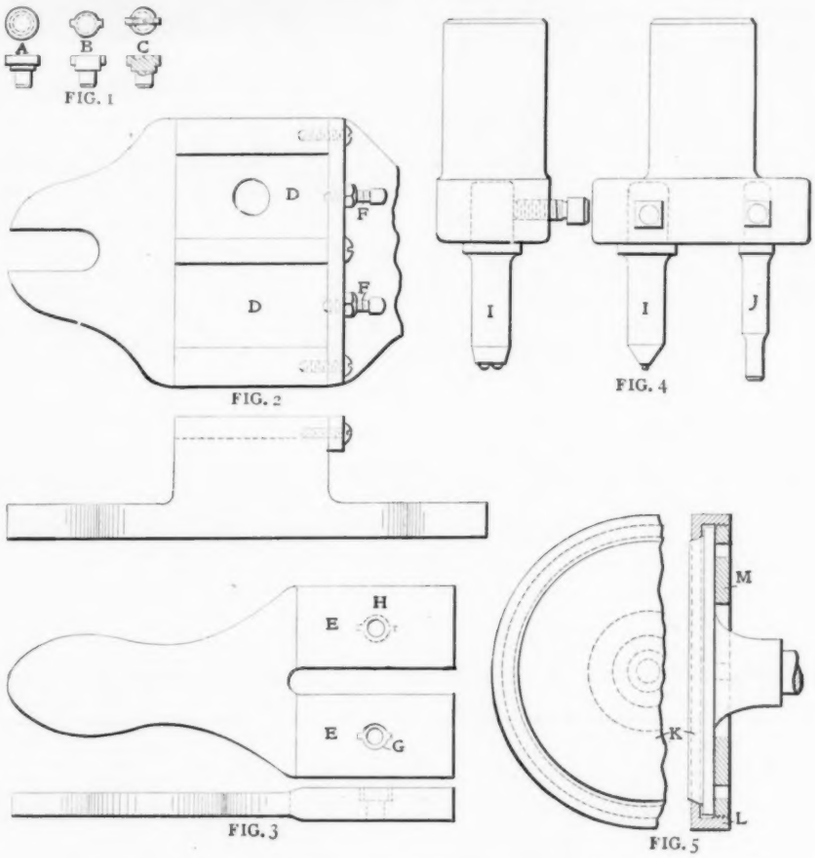


FIG. 1. FIG. 2. FIG. 4. FIG. 3. FIG. 5.

SOME PRESS TOOLS AND A POLISHING DISK.

A represents the die blank as it comes from the screw machine. It is then put through a punching operation which leaves it with two small lugs as shown at *B*. *C* is the finished die with the stamped impression for closing the stitches. It was during this operation that the time was lost. The operation was performed in a power press by a boy who placed the work in a steel plate having a hole shaped like the die; this plate was then slipped in a groove in a bolster which was bolted to the press so as to bring the die in line with the stamping punch After the die was stamped, the plate was drawn out. In the stamping the die swells, so that it has to be driven out and this was where the time was lost. No tool was made at that time for a knock-out, so the boy did the best he could with a hammer and punch. When the order went forth for improved tools the die holder and bolster were altered so that the stamping became a simple operation. Fig. 2 is a block with two grooves *D* into which slide arms *E* of the holder in Fig. 3. At *F*, Fig. 2, are two screws used when any slight adjustment is necessary. The die is placed in the pocket *G* in the holder Fig. 3, the plate is slipped into the bolster, and the die stamped. Then the plate is turned over bringing pocket *H* right side up and another piece is placed in this hole with the first piece remaining in *G*. The punch holder Fig. 4 carries two punches, *I* for stamping and *J* for a knock-out, and as the first of these stamps the die in hole *G* the knock-out forces the finished die out of the hole *H*. With these tools the boy is able to finish the work very quickly.

Fig. 5 represents a polishing disk for finishing the face of the die before stamping. This is used in the speed lathe. *K* is the head, *L* is a ring that fits over the front and *M* is a ring that screws into the back of *L*. A circle of emery cloth is cut a little larger that the face *K* and placed over the tapered portion, then ring

L is placed over this and drawn back tight by ring *M*. The emery cloth being held tight presents a nice level surface.

This tool may seem a little expensive in the making, but it pays for itself quickly on this class of work. When the sheet of emery cloth becomes worn it is very easily replaced with another and there is no bother heating glue, or scraping off old emery.

PEDRO.

A Spring Tool Holder and a Jig for Grinding Cutters.

Fig. 1 shows this tool holder and gives all the dimensions. The cutting tool can be put back against the shank at *A*, making it rigid if desired, and a number of

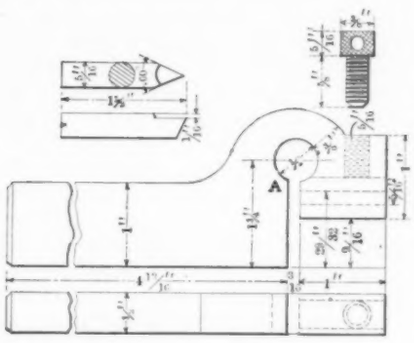


FIG. 1. SPRING TOOL HOLDER.

different tools can be used in the holder with satisfactory results. In Fig. 2 is shown a jig for grinding the tools or cutters to the proper angles and it will be seen that they are ground without being moved from the jig. They have 20 degrees clearance and are flat on top. I tried grinding these with a 2-degree lip on top, but they did not work so well as they had a tendency to dig in. All the angles I got by grinding and trying until the tool fitted the standard gage. The hole *B* for the inserted tool is drilled at an angle of 20 degrees and end *C* is finished at the same angle. The faces *DD* are at an angle of 62½ degrees which brings the cutter to 60 degrees when ground. It would be well to try your cutter when grinding this angle. Fig. 3 shows a jig on the same principle but with different angles for grinding 29-degree cutters for threading hobs.

C. W. T.

"Doing Worthless Work."

Dixie's article, on "Doing Worthless Work," at page 584, reminds me of a job I did for a chap some years ago.

He was a painter, working in a different department of the same concern where I was looking after the small tools. He came to me, and said he wanted a screw about a foot long, with a thread which would give the greatest forcing strength—meaning by this a fine thread. One end was to be squared so a monkey wrench would turn it, he also wanted a tap made the same size, and a drill the right size for the tap. I made the screw of ⅞-inch machine steel about nine inches being threaded 18 threads. The tap was about four inches long, to make a good close fit for the screw. As I had not been careful to make the thing any particular size, I had to make a flat drill, to get the exact size hole for the tap, there being no 1/64-inch twist drill sizes over quarter inch, in that part of the country at that time. I only charged him $5 for the outfit, as he was a fellow workman. It never occurred to me to ask him what it was for, and as he quit a few days later, I never expected to find out.

About a year later, I happened to see his name at the top of a column in a Toronto paper, under the head lines "Safe Breaking Operation." It went on to say that, alias 1, 2, 3, etc., had been caught in the act of attempting to open the lock of a country store safe with a peculiar sort of jack-screw. From the general description I gathered that I had seen that "peculiar screw" before.

His method had evidently been to drill somewhere in the door or side of the safe and use the screw to force the bolts back.

As I am not familiar with the mechanism of strong boxes, I can but conjecture where the screw acted, but act it did, as the police reports showed that several safes had been "cracked" with this same instrument. Had I known, or suspected at the time, what I was making, I would probably have squared that $5. The gentleman received 15 years in Kingston penitentiary, where he doubtless found plenty of time to think out several more ways of opening "them."

Should anyone read this who knows where or how such a screw could be inserted to open an old-fashioned safe, I am sure others, as well as myself, would be interested.

W. L. McL.

Canada.

Defective Core Ovens.

There are about as many castings lost through inadequately dried cores as there are from other causes, and there are several reasons for not having them dried, among them inefficient core ovens. A great deal depends on the design of the oven, its hight, and the location of the fire-box and flue. I remember some years ago some ovens being built in a large foundry in this city that were considered to be modern in every respect, and so they were for a time. The engineer in charge was considered to be one of the smartest men in the country but we are all liable to make a mistake; well, this man made a mistake when they put the top on the oven. It was quite a good sized one, about 25x18 feet and was quite a span for a flat arched roof. There were strong buck-staves all along the starting of the roof, with rods (about ten, I think) through them, but the strain of the roof pulled the thing apart so that they pulled the roof off and reconstructed it with a series of girders on the wall with small arches in between them; then it was leveled off and it made a good strong place for stock cores or store-room for flour. The fire-place was built at the further end of the oven and was bricked up over the top, which was level with the floor; there were flues built from the fire-box to the door of the oven and return to the back; in the corner on each side was a flue or chimney. The flues were covered with iron plates with holes for the heat to come through, but as I expected the flues soon got stopped up with dust and the fire would not draw, so the roof of the fire-box was taken off and a hole was broken into the chimney on the floor-lines. And it was all right afterward.

I worked in a foundry at one time where they had some corliss cylinders to make in dry sand and it being an agricultural foundry they had no use for a large oven, so they came to the conclusion to build an addition on the old one. This was about 8x8 feet, so they put on another 8 feet

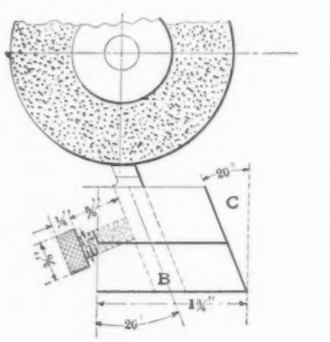


FIG. 2

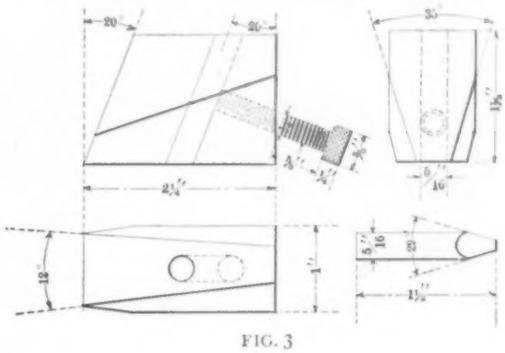


FIG. 3

THE GRINDING FIXTURES.

which made it 16x8 feet, then put in a dividing wall two feet from the end with a hole about 12 inches square at the top, then built a fire-place in this enclosure with a fire-door about 2 feet from the floor. As I saw the work progressing I spoke to the foreman about it; he said "I don't know anything about it, *they* are doing it" (that was the superintendent and his assistant). I put the mold in the oven and it was there three days and three nights and was not dry then, so I thought I would dry it or burn the oven down. Well I did something, and I had the fire department down there soon after. They had built the roof of the oven up under the beams of a pattern storage room and the natural consequence followed. The top of the oven was hot but the bottom was quite cold, so I started to pull down the wall between the oven and the fire and I found that it worked better every time after I had pulled down a few bricks; until finally when I had got the wall down level with the fire it was all right. The superintendent came in one day and saw the wall down.

"How did that wall fall down?"

I told him that every time the carriage was pushed in it struck the wall and knocked down the bricks.

"Well, I suppose I shall have to have it fixed up again."

"No, you don't need to, it works all right as it is," I said.

Last summer I took a run down the center of the State (Ohio); in a small town there was a foundry with about 5 or 6 molders in it. They were doing a class of small work, so that they did not need a very large oven, but they had a place where they dried cores that they called an oven. The superintendent told me that it did not dry the cores very well. I told him that I thought so, too. It was a place about 6x4 feet with a fire-box in it that would hold about three bushels of coke and the coremaker told me that the cores were not dry the next morning after putting that much coke on the night previous. The reason was very simple, there was a hole in the top of the oven with a pipe from it going into a large chimney, and all the heat went right straight out through this pipe. So I told them instead of going to much expense to rebuild the oven, to put a damper in the pipe, and leave it open till the fire had burned up well, so they did and instead of using three bushels of coke one was enough and instead of putting the cores up to the top of the oven as they did before, they could dry them on the floor.

There are many good ovens in the country, but the best that I have seen are at the Morgan Engineering Works, Alliance. They are heated by gas. In the large ovens there is a perforated pipe on each side of the oven from the door to the back wall, with a valve outside to regulate the gas and they are good, the best I ever used. Then they have another where they dry the small cores. This oven has three carriages in it heated the same way, but its main feature is that the doors are on the carriages. There is a door on each end, so that when one is drawn out to load or unload the door is closed by the door on the back of the car so the oven can be kept hot all the time, as there is no heat escapes except during the time the carriage is coming out.

Cleveland, Ohio. THOS. WATHEY.

A Believer in Tool-Holders.

In the days of the high-carbon tool-steel which could be bought at from 14 to 25 cents a pound very few shop owners cared to bother with the tool-holders, but at the present time if you are up-to-date and wish to keep up with the other fellow you buy high-speed steel, and when the bill comes in ! ! ! well, we will not put down here just what you say when you figure your one per cent. for cash in ten days. Four years ago you did not figure your cash discount as it did not pay you, but today when they hand you a bill that looks like 70 cents a pound you scratch your head a little and begin to wonder if there can't be some way of cutting your steel bills down some. Now right here I wish to ask Mr. Superintendent or Master Mechanic if he ever got right down to business and went into his own shop and gave the tool-holders a fair show to see what they would do for him in the way of cutting down that steel bill; I will venture to say that if he did they are now using quite a few of them.

Some time ago I received a bill for a bar of 1¼x⅞-inch and it looked something like this: $28.00, and lucky was the tool-holder salesman who called on me that day almost to the hour the bill came. The young man came into the office and after a few remarks, such as "What a swell shop you have" and "Have a smoke with me," started in to tell me what tool-holders would do for me and from what he said I don't think there is any work inside of a machine shop, outside of sweeping the floor, that they will not do. After some more of what I considered "hot air" at the time, I accepted his offer of placing with me a set of holders on thirty days' trial. Now "Mr. Small-shop owner," you know from your own experience that about one of the first things a steel salesman will tell you is the record his steel has made turning locomotive tires. Well, this young man got so interested in talking tool-holders that I thought I had him when he told me that he could mention a few shops where they were so far advanced that they were turning locomotive tires with holders; I thought that that was just about the limit, but upon investigating I found out that he knew what he was talking about.

At the Chicago, Burlington and Quincy shops, Aurora, Ill., I found them doing the following : Cutting speed 14 feet per minute, feed 3/16 inch, steel 1 inch square used in tool-holder.

At the Chicago & Northwestern shops, Chicago, you will find them using nothing but tool-holders with these results: Cutting speed, 16 feet per minute, speed ¼ inch, steel 1¼-inch square. There is one thing I would warn you against, and that is this, if you wish to find out just how fast the different shops are running their wheel lathes do not go to a master mechanics' convention, for as a general rule they are a lot of good fellows and will not talk anything under 20 or 25 feet per minute, but just slip around some day when they are not looking for you and put your speed indicator to the work and their 25 will look more like 14 or 16. I think the recent test at the West Albany shops of the New York Central & Hudson River Railroad is good proof of this, as on eleven machines the cutting speed varied from 8½ to 14 feet per minute.

The set of holders I received on trial were never sent back, but in place of one I am now using about 20 and as I consider the average life of the holders about seven years it will be some time before I will have to invest again, and in the meantime I will be saving about 8/10 of my steel bill, 40 per cent. emery wheels and $5 to $7 a week for forging, not saying anything about the time the men save by having a tool that is always ready to work with.

L. H. WEBSTER.

Trouble with an Upright Drill.

A short time ago we had a rather annoying thing happen to an upright drill in our shop, and I thought perhaps an account of it might interest your readers, and maybe draw the attention of designers of this class of machine to a point which they seem to have overlooked.

In the machine in question, the chain which carries the balance weight is, at its other end, attached to a small hook which in turn is screwed into the spindle sleeve.

If by any inadvertence the operator should run the spindle too high, then this hook strikes against the top bearing, and in our case these repeated blows eventually broke it off short and the operator was shocked to see the chain vanish from sight inside the column of the machine.

He stopped the machine, and proceeded to examine it closely in the vain hope that there might have been some provision made for such a contingency, but unfortunately there was none, so after various plans had been brought forward, each only to fail, there was nothing left to do but detach the belts, unscrew the foundation bolts and lift the drill a sufficient hight to withdraw weight and chain. It will readily be understood that this was an operation involving a considerable

amount of time and labor. When the chain and weight had been extracted we naturally expected that the rest would be plain sailing, but here again we were grievously mistaken for the problem of getting that chain over the pulleys and through the arm of the drill had still to be overcome. We tried copper wire that was too thin to stand forcing, and coiled up inside the bend without making any progress, then we got some that was thicker, but this was not sufficiently flexible to go over the pulleys, and therefore stuck. The next dodge was suggested by some genius and consisted of a long, narrow piece of lead attached to some thin string, and bent to the curve of the pulleys. With the aid of this we finally succeeded in threading the chain into its place, but I can assure your readers that it was not without the expenditure of a large amount of time and patience, to say nothing of indifferent language.

There are several ways of preventing a recurrence of this, the two we adopted being; firstly, that of screwing two small studs into the sleeve at its upper and lower ends, so that they act as stops, and prevent the hook striking; and also, as an additional safeguard, of putting through the end link of the chain a bolt of sufficient size to prevent the chain running through the column even if the hook does slip or snap.

The method of building machines of this class without any provision for threading the chain and placing weight, without dismantling entirely, is open to condemnation, for in addition to causing the trouble above mentioned, which might happen frequently, and particularly when the drill becomes old and the chain rusty, there is another point against it and that in the difficulty of packing for export, etc.

As usually sent out, the weight and chain are threaded and in position, the former being prevented from moving by wedging in the column with blocks of wood, these being driven in all around and the ends cut off. These wedges must be tight to prevent the weight breaking loose and doing damage in transit, therefore the difficulty of extracting them when the machine reaches its destination can be imagined. In some cases there is nothing for it but to drill, chip or burn them out, which of course means an absurd waste of time.

The remedy is so simple that one can only wonder why it has never been applied; it consists of coring one or two hand holes in the column, and it should not be difficult to place these in inconspicuous positions and also where they would not seriously weaken the structure. If this were done, then the weight could be packed separately and I think the saving in trouble all round would justify the alteration.

F. H. HARRIS.

Newcastle, Eng.

Pneumatic Tube System for Delivering Blueprints, Orders, etc., at the General Electric Works.

The General Electric Company at Schenectady, New York, formerly employed messengers for delivering orders, letters, routine reports, blueprints, etc., from the executive offices to the different departments and for communication between departments. These messengers were despatched every half hour and it took from one-half hour to one hour to cover each route. On account of the bulk and importance of the papers to be transmitted, there were frequent vexatious and costly delays and a great many petty annoyances, and the management of the company conceived the idea that a system of pneumatic tubes would not only rectify the troubles incident to the employment of a large number of boys for this purpose, but would make possible a systematic scheme of periodical reports during the day and bring the various departments in closer touch with each other.

A study was made of the general layout of the plant and the course which the various documents should take from their points of origin and from the data lines were laid out as follows:

From the central station which is located in building No. 5, which contains the marine department, five independent lines were run to the executive office in building No. 2, to the blueprint department in building No. 4, the testing department in No. 11, the shipping department in No. 12, and to building No. 84, in which is located the central station for the lower half of the works. From building No. 84 independent lines were laid to the pattern department in building No. 77, the foundry department in No. 83, the wire and cable department in No. 93 and the turbine department in building 86. Connection was also made with the wireless telegraph station.

FIG. 1. CENTRAL STATION AND POWER PLANT IN BUILDING NO. 5.

An examination of the various documents and forms handled showed that a 4½-inch tube would be sufficient to handle all business and an extra long carrier was designed of sufficient size to take in the largest blueprints to be

transmitted. It was not possible to run the tubing overhead from building to building on account of traveling cranes, cables, wires, etc., so it was placed under ground, below frost line wherever permissible. The joints were made with soldered sleeves. As a portion of the grounds are quite low, it was necessary to make the joints water-tight at these points by means of special couplings. The extreme length of the carrier made it necessary to use cast-iron bends having a 5-foot radius enlarged in the center instead of tube bends of a longer radius. These bends were put in the manholes where are also located the drips, and the pipe was so laid that it would drain itself toward the manhole in which the drips were placed. These drips are automatic in their action and drain themselves free from water at night when the system is closed down.

The terminals within the various buildings are of the double-door type, insuring positive delivery of the carrier without interrupting the current of air flowing through the tubes. The dispatching inlets are of a closed type so that the flow of air passing through the tube is not interrupted when a carrier is dispatched.

There are two power plants, one of these, shown in Fig. 1, is in building No. 5, and takes care of all tube lines for buildings Nos. 2, 4, 11, 12 and from No. 84, the other one being located in No. 84, and taking care of the tube lines from buildings 5, 77, 83, 86 and 93. They consist of high-duty exhausters of the Connersville positive type, operated by electric motors. The method of operation is as follows: The correspondence that comes to the excutive offices in building No. 2 is put into carriers, and sent from a station seen in Fig. 2, to the central station, Fig. 1, in building No. 5, where it is re-distributed, and sent to the various other buildings, but in case there is sufficient correspondence to fill one carrier, say for the wire and cable department, it is put into a carrier and marked "Building 93," which means that it is an express carrier, and not to be opened. This gives it the right of way until it reaches its destination. The distance from building No. 2 to building No. 93 is three-quarters of a mile, and the time required for the carrier to travel this distance, including the handling of the carrier is three minutes. In case the shipping department wishes to inquire from the testing department when a motor will be ready to be delivered to them for shipment, the request goes from building No. 12 (a sub-station in which is shown in Fig. 3) to building No. 5, and if it is an express carrier it goes immediately to No. 11. The time required for this transaction is about two minutes. The information being obtained, is returned to the shipping department, the whole transaction not taking on an average over five minutes, and the report being in writing is a positive record. Payroll slips are made up in the different departments and forwarded to the executive offices in building No. 2. This is done after, or about closing, every afternoon. Orders to the foundry from the executive offices reach the foreman in about three minutes from the time they are issued. This is true also of orders to the pattern department for the changing of patterns, or the getting out of patterns. The transactions referred to above approximately consumed from one-half an hour to an hour to get them from the point of origination to the point of destination under the old method, and there was no certainty, or evidence, that they ever reached their destination. The system has been the means of dispensing with a great many messengers, but the greatest gain has been in the rapidity and reliability with which business is transacted. Small metal parts, wire cable, etc., which formerly were sent by messengers, are also sent through the tubes. This is also true of small tools; in fact, everything that can be sent through the tubes now goes that way. Between five and six miles of tube are in operation, and there are probably 800 to 1000 despatches in a day.

This pneumatic-tube system was installed by the Lamson Consolidated Store Service Company, of Boston, Mass.

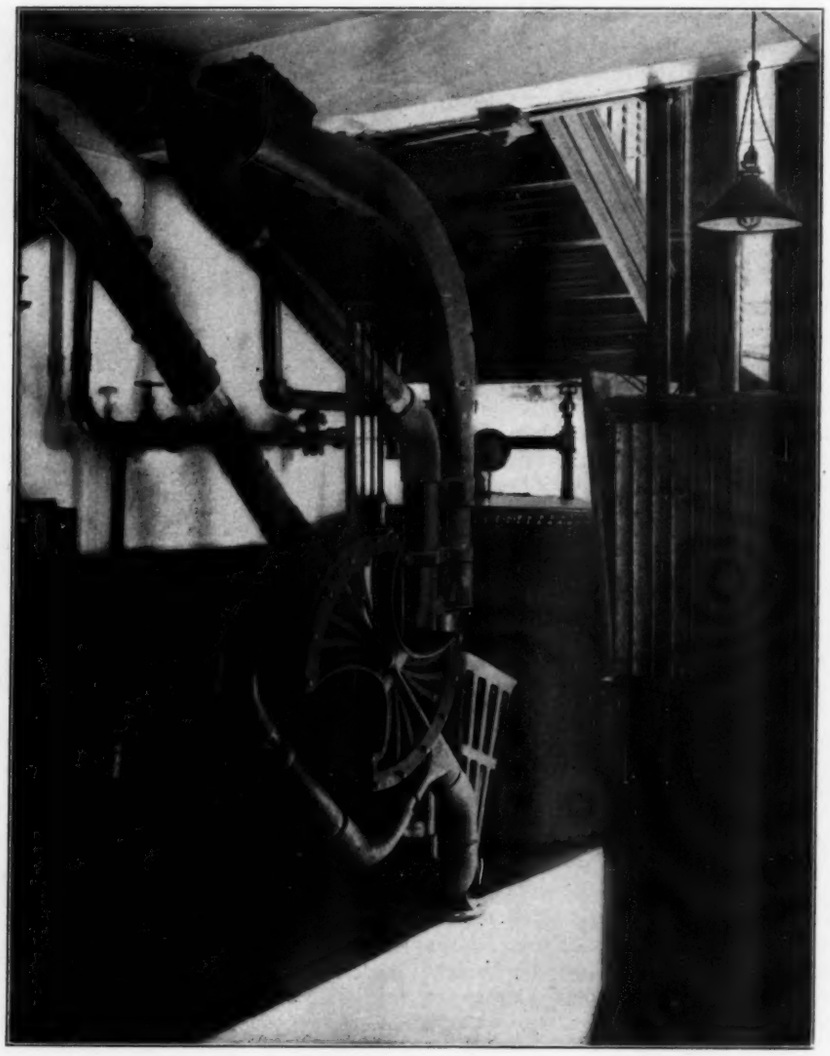


FIG. 2. STATION IN BUILDING NO. 2.

An English View of "Follow-Up" Methods.

"Follow-up" methods are affairs which engage much of the attention of occultists in the new advertising. Their jargon is sometimes a little mystifying, but we understand "follow-up" to be the art of converting inquiries into firm orders for goods. To see to what a length the art has been developed it is only necessary to ask further details about some of the medical or toilet articles advertised profusely in the magazines. For weeks afterward facsimile typewritten letters flow in, signed by all manner of officials attached to the advertising firm. These are couched in every tone, from covert menace or reproach to abject entreaty, and they end sometimes by an offer to supply for £1 the thing for which £2 was asked in first in-

stance. This is the disreputable form of "follow-up" by which chiefly women and minors are persecuted, but there is a more legitimate way of bringing pressure to bear to ensure a fairer consideration. Presumably most business firms, and more especially those who advertise, are in the way of receiving occasional inquiries from persons unknown for quotations, catalogs or patterns. These are treated with diverse degrees of respect by different recipients. Some, on the off chance of an order, go to great pains to comply with the request made. Others, while complying more or less perfunctorily, betray no great anxiety to do business, contenting themselves with a formal written answer. There are the pessimists who ignore whatever inquiries look superficially unpromising. And, of course, there are the high-pressure enthusiasts who telegraph immediately that their representative is leaving by the first train to call on the inquirer. These are the courses of action taken by different types of men competing in different lines of trade, and it would be unwarrantable to suppose that they do not know what is good for their own business. A certain proportion of them are tempered in their eagerness for business by the knowledge, which is easily verifiable, that the world contains a good many people whose instinct is to reply to advertisements out of an idle curiosity that has little economic value. A review of casual inquiries from year to year will show that some obscure and distant individual, who perhaps is a collector of catalogs, or is the victim of a mania, makes repeated requests for particulars of articles that he is in no position to buy. At least so much can be said in defense of esteeming these straws lightly.

FIG. 3. SUB-STATION IN BUILDING NO. 12.

But it is proverbial that courtesy in business pays. Relatively to its cost, no outlay brings so handsome a return, and we may believe that even a liberal display of deference and attention to casual or extraordinary communications will finally be well repaid. The attitude of British firms is perhaps not far removed from that of Americans in questions of "follow-up." If we might believe all we hear as to American acumen and enterprise in dealing with openings for business, Americans might be regarded as more eager and energetic. But, taking the account recently supplied by an American engineer of his experience in dealing with fellow machine builders, it would seem that their practice is not regular or perfect. Needing to buy equipment for a workshop, he wrote letters to forty or fifty firms stating his needs and intentions, and inviting special recommendations of suitable appliances. Only three firms failed to reply at all, only one sought insistently to sell its catalog, and only one sent a list of absurdly unserviceable tools. At least 60 per cent. of the addressed sent dry, stereotyped, and non-informative letters with their catalogs. One leading house sent the catalog without letter or quotation at all. A dozen, or about one-fourth of the whole, sent "letters which were a pleasure to read," with all the suggestions, prices and particulars that could be desired, and two or three of these asked the customer to visit the works at their expense and judge of everything himself. Naturally enough, the firms who had deserved best came off best in the distribution of orders. The purchaser took what he was obliged to take from those who made a spiritless response, and showed his feeling as to the heedlessness of the others in a cool and argumentative letter to the AMERICAN MACHINIST. Few buyers would gratuitously go to the same trouble to remonstrate with slow and unappreciative sellers at large, and the value of this analysis consisted largely in its temperate tone. Sellers are left usually to divine for themselves whether any want of tact or timeliness is responsible for their want of success in particular instances. Of course importunity has its dangers no less defined than those of apathy, but the judicious mean is not hard to strike. Without impressing an inquirer with the conviction that one is dying for want of business, it is easily possible to show a practical kind of cordiality that will bear good fruit in some quarter some day. Is it not in following up inquiries that one has the supreme chance of imbuing strangers with the notion that the firm is a "nice one to do business with." That, obviously, is an opinion to encourage and justify at all reasonable costs, and well worth some show of patience over troublesome corespondence. —*The Manchester (Eng.) Guardian.*

It is announced that the largest wall paper factory in the world is about to be built near London on the Thames for the Wall Paper Manufacturers, Limited, and that the plant will be designed by Americans. Much of the material for the building will go from here, and practically all its equipment, including the engines for driving the machinery, which will be of 4000 horse-power capacity. Joseph H. Walsh, of New York City, will design the plant, and is the chief engineer. It is expected to include every improvement in the art of wall paper manufacturing.

Test of "Compo" Cork Insert Friction Plates.

The following is a report of a test made under the supervision of Ira N. Hollis, Professor of Engineering, Harvard University, of "Compo" friction plates, illustrated and described at page 576; together with curves of the results. The reliability of the test is certified by Professor Hollis. The test was undertaken to determine the value of cork for increasing the frictional resistance of metallic surfaces in contact.

The pieces to be tested consisted of five cast-iron and five phosphor-bronze plates 5 inches wide by 10 inches long by ¾ inch thick. One side of each plate had been planed smooth, and one plate of each metal had, respectively, 0, 11, 14, 17 and 48 holes ¾ inch in diameter by ½ inch deep, drilled in the smooth side. The holes were located symmetrically in the plates and in rows, staggered. They were drilled flat at the bottom.

Corks 1 inch in diameter were compressed and placed in the holes wet, allowed to dry, and driven home hard. They were then sandpapered down to 1/32 inch projection above the surface of the metal. Before commencing a test, the plate was dragged back and forth several times under a load of about 500 lb. to reduce the corks to a uniform condition, and one that would remain uniform throughout the subsequent test.

The surface on which the plates were dragged consisted of a cast-iron plate with the upper horizontal surface planed smooth.

The pull to overcome friction was applied by means of a pianoforte wire, one end of which was attached to the plate and

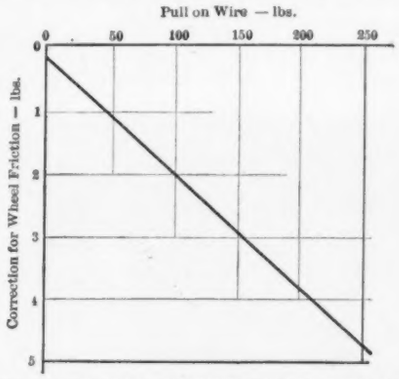


FIG. 1. DIAGRAM SHOWING RESULT OF CALIBRATION OF PULLEY-WHEEL.

the other hung over a wheel of known resistance.

CORRECTION FOR FRICTION OF WHEEL.

The wheel was calibrated for friction as follows: Weights on the lower end of the wire were alternately hoisted and lowered by means of a spring balance attached to the horizontal part of the wire, and half the difference of the balance readings, up and down, was taken as the correction for the given weight. These corrections, to be subtracted from the weight on the wire to give the pull in the horizontal part, are shown plotted in Fig. 1.

VELOCITY AND LOADING.

Weights were hung on the lower end of the wire to keep the plate moving at uniform velocity when started. The velocity obtained was between one and two feet per minute. It is probable that the coefficient of friction varies somewhat with the velocity, and experiment seems to indicate that the coefficient would be higher for greater velocities. If this is true, the results obtained in these tests show lower values than would be realized in the practical use of "Compo" surfaces for brakes and clutches.

Tests were made on each plate under eleven loads, varying from 50 to 550 lb., by 50-lb. increments. The weights were piled upon the plate, a test being made after every addition of 50 lb., and again after each removal of 50 lb., as the weights were being taken off. A mean between the two readings for each load, corrected for the resistance of the wheel, was used in plotting the curves.

DISCUSSION OF CURVES.

The curves show that the coefficient of friction for plain cast iron on cast iron is about 0.16; that is, where W represents

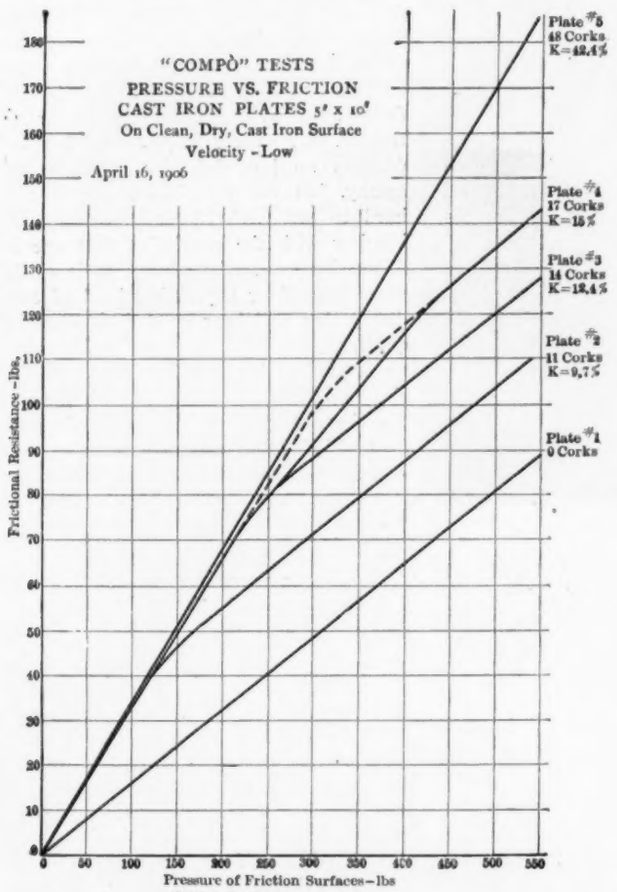


FIG. 2 Both Plates Cast Iron

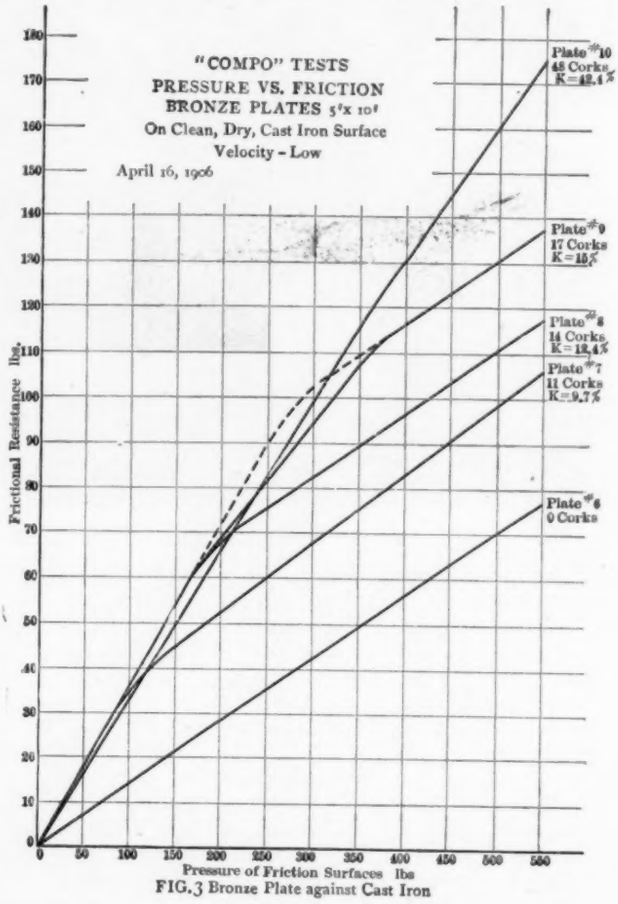


FIG. 3 Bronze Plate against Cast Iron

DIAGRAMS SHOWING RESULTS OF TESTS, WITH AND WITHOUT CORKS.

the pressure on the surfaces and R the frictional resistance,

$$R = 0.16\ W.$$

For plain bronze on cast iron, the coefficient of friction is 0.14, or

$$R = 0.14\ W$$

The coefficient of friction of the corks on the cast iron is from 0.33 to 0.37, 0.33 being the value for the heavier loads. Therefore, while the cork is being compressed under the load and the metals have little or no contact, the resistance is,

$$R = 0.33\ W$$

It may be noted that at a definite "critical" point the curves of the "Compo" friction plates become straight lines parallel to the line indicating the resistance of metal on metal without inserted corks. This is due to the fact that at a certain "critical" load, the corks have been sufficiently compressed to bring the metallic surfaces into close contact. In plates No. 4 and No. 9 the premature and partial change of slope may be due to an unevenness of the corks, allowing one side or one corner of the plate to come into metallic contact with the bed plate. The final slopes of these two plates occur when the entire metallic surfaces are forced into contact by the load. The dotted lines, shown in connection with the curves for plates No. 4 and No. 9, represent what the curves would have been had the corks been even.

D = ½"		D = ⅝"	D = ¾"	D = ⅞"	D = 1"
S	K %	K %	K %	K %	K %
1"	10.6 %	31.7	44.2	60	
1⅛"	13.5	24.3	35.	47.5	
1¼"	12.6	19.6	28.3	38.5	50.3
1⅜"	10.4	16.2	23.5	31.9	41.6
1½"	8.7	13.6	19.7	26.7	35.
1⅝"	7.5	11.6	16.8	22.8	29.8
1¾"	6.4	10	14.5	19.6	25.7
1⅞"	5.6	8.7	12.6	17.2	22.4
2"	4.9	7.7	11	15.	19.7
2⅛"	4.4	6.8	9.8	13.3	17.4
2¼"	3.9	6.1	8.8	11.9	15.6
2⅜"			7.9	10.7	14.
2½"			7.1	9.6	12.6
2⅝"				8.7	11.4
2¾"				8.	10.4
2⅞"				7.3	9.5
3"				6.7	8.7

D = Diameter of Sockets
S = Spacing or Pitch of Sockets
K = Area of Cork in per-cent of Total Area

FIG. 4. TABLE SHOWING PROPORTIONATE AMOUNT OF CORK SURFACE.

Above the critical point, the cork takes no more pressure and the load merely increases the pressure between the metallic surfaces. Below the critical point the frictional resistance increases with the load at a rate measured by the coefficient of friction of cork on metal. Above the critical point, the frictional resistance increases with the load at a rate measured by the coefficient of friction of the metals, and the total resistance is the sum of the constant drag of the corks and the frictional resistance of the metals due to the additional pressure, after that carried by the cork is subtracted from the total load.

FORMULAS DERIVED FROM THE TESTS.

The curves and tables for loads above the critical point may be expressed in mathematical symbols as follows:

$$R = f\,W + N\,A\,(K - a)$$

Where R = resistance to motion of plate;
W = total load on plate;
f = coefficient of friction of metals;
A = total area of plate;
K = area of cork in percentage of A;
N = a constant depending upon the nature of the materials and the conditions of their use;
a = another constant.

If r represents the frictional resistance for each square inch of surface, and w the pressure per square inch, this formula may be written

$$r = f\,w + N\,(K - a)$$

In order to make this formula practical and useful, it is necessary only to determine the value of the constants from the tests. The equations then read, with close approximation, for loads above the critical point:

For cast-iron "Compo,"

$$R = 0.16\,W + 0.12\,A\,(K - 6)$$

or

$$r = 0.16\,w + 0.12\,(K - 6)$$

For bronze "Compo",

$$R = 0.14\,W + 0.126\,A\,(K - 5.7)$$

or

$$r = 0.14\,w + 0.126\,(K - 5.7)$$

The critical point occurs when, for cast iron,

$$W = 0.71\,A\,(K - 6)$$

or

$$w = 0.71\,(K - 6)$$

for bronze,

$$W = 0.66\,A\,(K - 5.7)$$

or

$$w = 0.66\,(K - 5.7)$$

SUMMARY.

For cast-iron "Compo" on cast iron,
When W is less than $0.71\ A\,(K - 6)$
$$R = 0.33\,W$$
When W is more than $0.71\,A\,(K - 6)$
$$R = 0.16\,W + 0.12\,A\,(K - 6)$$
For bronze "Compo" on cast iron,
When W is less than $0.66\,A\,(K - 5.7)$
$$R = 0.33\,W$$
When W is more than $0.66\,A\,(K - 5.7)$
$$R = 0.14\,W + 0.126\,A\,(K - 5.7)$$

While not exact, these formulas represent actual results with sufficient accuracy for engineering purposes.

May 1, 1906. JOHN R. NICHOLS.

A useful application of the recording pyrometer, which instrument has of late undergone considerable improvement, promises to be the oversight of the temperatures of flue gases in boiler plants. Some of these instruments are now as simple to read as a volt-meter, and their installation should make quite an important contribution to the saving of fuel.

Prices Abroad Advancing.

Consul Joseph I. Brittain advises from Kehl that at a joint meeting of the Hotel Proprietors' Association and Restaurant Keepers' Union in Strassburg all prices on the bills of fare were advanced from 10 to 30 per cent. from May 1.

One restaurant proprietor who was interviewed said they were obliged to increase their prices to customers in consequence of the continual advance in the prices for meat, vegetables and other food products in Strassburg. He stated that they were also obliged to pay higher prices for labor; this advance he claimed was in some cases equal to 50 per cent., and cited as an example his cook, who now receives 120 marks (mark=23.8 cents) per month, whose former wages were but 80 marks. He also stated there had been an advance in the prices for cooking utensils. It is said similar advances have been made by hotels and restaurants in various parts of Germany. There appears to be a decided upward tendency in prices in Germany, which will doubtless make it more difficult for German exporters to compete with other countries in foreign markets. These advances pertain to raw materials, manufactured products and labor.

AUSTRIAN GOODS WILL COST MORE.

Consul Urbain J. Ledoux, of Prague, records the upward trend in the prices of Austrian productions, as follows:

The manufacturers of celluloid wares of Austria-Hungary have raised their prices by 10 per cent., giving as a reason the extraordinary rise of camphor in Japan.

The shoe manufacturers of Prague have met the demands of the workmen respecting the shortening of working hours and increased pay, in consequence of which, and also owing to the higher cost of all raw materials, it has been decided to increase the prices of shoes and shoe wares by 20 per cent. This should materially help the sale of American shoes, which have gained considerable popularity in the district, but are considered as a great luxury, owing to their much higher prices than the local products.

HIGHER COST OF LIVING CAUSES STRIKES.

While trade in general shows all the symptoms of a steady improvement, the strike movement in Bohemia has assumed serious proportions, causing local manufacturers great losses and embarrassments. At a shirt and collar factory in Prague the cutters have gone out on strike, and in consequence the proprietors have given a fortnight's notice to all their employees. One of the large breweries at Pilsen brought a strike to an early close by allowing their employees an increase of wages of 10 per cent. The chief argument of the workmen in formulating their demands is the present increased cost of living.

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An Injury to All American Business.

The report comes from England that the business of the American life insurance companies there, which had already been seriously injured by the disgraceful revelations of the manner in which the business of the companies had been carried on is likely to, and indeed already has been, still further prejudiced by the still more disgraceful revelations of the manner in which the business of the meat-packing companies is carried on. Englishmen are asking Americans if there is such a thing as commercial honesty in America, if the climax to the story of devilish scoundrelism has yet been reached, and we can scarcely blame those who are concluding that the answer to both these questions is negative, and that they must keep clear of all commercial intercourse with Americans.

Though this sentiment will of course have little influence in the lines of machinery and of engineering work, we fear it will have some, for there are those who will be ready to make the most of it, and in spite of all that can be said or done the business and industries of any country are in a sense tied together, and that which causes one branch to suffer in reputation will more or less affect all the others. Foreigners can hardly be blamed for bunching the people of a nation together more or less, and saying that all are tarred with the same stick. We do it ourselves and there is everywhere entirely too much of such bunching and of referring to the business men and manufacturers of a given country as though all were alike, and particularly as though all were like the few known questionable or dishonorable ones.

We hope the injury to our machinery interests will be inconsiderable, for of course it would be most unjust that it should be otherwise, and in the mean time it is the bounden duty of every American to do all he possibly can to set our house in order.

No class of citizens is now doing so much to injure our reputation and destroy confidence in us as are those who have been looked up to as examples of commercial success and as the pillars of our society. Something like a decent regard for ordinary business honesty must be restored in lines of business where it seems to have been lost; and if this is not done, and if it is not capable of being proven that it has been done, American commerce generally will be irreparably injured.

It is scarcely conceivable that any normal human being knowingly could be responsible for the condition of things in the Chicago packing houses. Probably not one of the monsters who are responsible for it could have allowed himself to become so except by gradual downward steps taken with increasing rapidity as consciences became seared. It is probable that the only effectual remedy will be the absolute wide opening of every place where food for human beings is prepared so that at any hour of any day whosoever chooses can go about upon observation galleries and have free access to and unlimited opportunities for observing in his own way every minute thing that takes place there. Experience in other countries as well as in our own shows clearly enough that human nature is not to be trusted in these matters. Not only every packing house but every hotel and restaurant kitchen, bakery or other place where food is prepared should be at all times open and subject to inspection by those who care to see them; and an analogous state of affairs must evidently be inaugurated with respect to the management of the Pennsylvania and all other railroads, and all other public-service corporations, including insurance companies. The general standing of our American commercial and manufacturing interests is involved in this matter and the most thoroughgoing and radical reforms are imperatively required. Our house cleaning must go on and must include the cellar, the garret and all between.

The Varying Meaning of Shop Terms.

A friend who has a practice as a consulting engineer, and who wanted to use certain parts of a regularly manufactured machine of the drill-press type, ordered and paid for these parts "ready to assemble," the correspondence making that feature of the case clear.

When the parts arrived, however, the end of the arm had not been bored for the table, and when our friend complained that this part was not "ready to assemble" in accordance with the order and the terms of its acceptance, the seller replied by a statement to the effect that according to the method pursued in his works the parts were really ready for assembling. In the meantime, as the buyer was in a hurry for the machine he did the boring himself, and rendered a bill for the work. This bill, equivalent to an asked-for deduction from the purchase price, the manufacturer refuses to pay, and as he has the money of the purchaser it looks as though he would not have to pay it, for the amount is not sufficient to make a suit worth while.

How the courts would decide such a matter, it is perhaps a little difficult to predict. It is clear that we have two distinct ideas of what constitutes "ready to assemble." The boring of the arm of a drill press to receive the table is usually done after the machine is otherwise completely assembled, this being done so because it is the simplest way of getting the boring in line with the spindle and thus having the table true. It is well known that in shops where this is the practice, the machines are said to be "ready for assembling" before this boring

is done and the builder might therefore be perfectly sincere in stating that the arm of one of his drill presses sent out unbored was "ready for assembling."

But the man receiving it would be almost certain to regard it as not at all ready for assembling. He may not design to use it on a machine equipped with an automatically fed spindle; he may have no suitable boring bar, nor fixtures for supporting one, and the job of boring may easily mean for him an expensive job in the lathe. From the purchaser's standpoint, therefore, the part certainly would not be ready for assembling by any means. The builders' interpretation of the expression "ready for assembling" would, we think, generally be considered much too special in character to make it incumbent upon a customer to understand it without specific and detailed explanation.

It is a situation peculiarly liable to lead to misunderstanding and dissatisfaction and whether the parties to the present dispute are able to come finally to an agreement or not we hope that by thus calling attention to it we may impress upon others the necessity for recognizing the fact that shop terms and expressions do not mean the same thing in all shops and that in very many instances there will be an utter failure to understand a given term or expression unless its real meaning in the vocabulary of the man who uses it is fully explained.

It is notorious, for instance, that no one has the least idea what "first-class workmanship" or "accurate" or "precise" or "large and long bearings" or "strongly back-geared" mean, unless something is known of the practice of the shop in which these expressions are used. It is not so generally known, probably, that "ready for assembling" may mean two or more entirely different things. The general understanding of it in nearly all shops would be that all machining or tooling on the parts had been done, and that they were ready to go together, with such adjusting or fitting as would naturally be expected in order to secure proper contact and action. Any other interpretation of the expression must be special and based upon the specific practice of the shop in which it is used. Lawyers thrive upon variant interpretations of technical expressions, and it is wise to make sure that "the other fellow" understands your use of such terms.

New Publications.

"Shaft Governors." Van Nostrand Science Series No. 122. By W. Trinks and C. Housum. 97 3¾x6-inch pages, with 27 illustrations. D. Van Nostrand Company, New York. Price 50 cents.

Notwithstanding the mysterious and obscure actions to which shaft governors are subject, there has been no adequate published analysis of them, and the authors of this volume, who have had large experience with these devices, have done a real service in publishing such an analysis, together with its application to various actual governors.

"Hilfsbuch für Dampfmaschinen-Techniker." By Josef Hrabak, Imperial Royal Court-Councellor, Emeritus Professor at the Imperial-Royal Mining Academy, Pribram. Fourth edition, illustrated. Three volumes comprising 672 8x10½-inch pages. Julius Springer, Monbijouplatz, 3, Berlin. Price 20 Marks.

This work, which now in an enlarged form enters its fourth edition, is intended for steam-engine designers, and is concerned with the thermodynamical side of the subject rather than with the mechanical details. It is arranged in "practical" and "theoretical" parts, the former consisting largely of tables. The fourth edition is marked by some additions to the matter treated. Beside an increased attention to high pressures, there are incorporated departments on superheated steam and on blowing engines. The superheated-steam treatise is based, apparently with some revision, on a separate work by the author concerning that subject, which was published in 1904.

"Des Ingenieurs Taschenbuch, Herausgegeben vom Akademischen Verein Hütte." 19th edition; two volumes, cloth, 1334 and 926 4½x7⅛-inch pages, respectively, with over 1600 illustrations. Berlin, 1905: Wilhelm Ernst & Sohn. Price (two volumes), 16 marks; or in durable leather binding 18 marks.

To any engineer who has worked in Germany, or with engineers educated in German-speaking institutions, it is unnecessary to introduce the widely known "Hütte" handbook, or "pocket-book." We have in English so-called "pocket-books" designed for some particular branches of the profession, but we have no equivalent for this comprehensive epitome of tables and data in all branches of engineering. As to which plan is preferable, there may be a difference of opinion. That the Society "Hütte" realizes the importance of keeping such a book up to date to correspond with the progress in the science and art, is shown by the fact that though a few years ago 300 pages were added in the issue of the eighteenth edition, we now have in the nineteenth edition a further increase of 260 pages, and an increase in the number of illustrations of not far from 200. To avoid raising the price of the book as a consequence of this addition, the binding has been changed from flexible leather to bluish-gray cloth, those who wish the leather binding being still able to secure it at an extra cost.

In a book of this size, covering such a multitude of subjects, it is important to have every facility for rapidly finding the data desired. Toward this end, we find first at the beginning of each volume a table of the contents of that volume, and in the back of each volume is the whole alphabetical index for both volumes, the roman numerals I or II before the page number indicating in which one any particular item can be found. Furthermore, this edition has the following new feature: On opening the book we find at the top of the left-hand page the numbers and titles of the section and sub-division, and at the top of the right-hand page the exact designation of the subjects treated on those two pages.

The following list will show the main divisions and also gives the number of pages occupied by each, which will permit of comparison with earlier editions:

Volume I. Mathematics, 128 pages. Mechanics (solids and liquids), 141. Heat, Thermodynamics, etc., 84. Mechanics of Materials, 106. Properties of Materials, including chemical elements with their atomic weights, etc., metals, stones (natural and artificial), mortars, plaster, cements and concrete, glass, rubber, waterglass, asphalt, etc., wood, lubricants, leather, fuels; though it must be said that some of these get off with a rather small assignment of space. 125 pages. Machinery Details, 218 pages. Prime Movers in which section under the subdivision of steam engines, we find 46 pages with numerous illustrations given to valve gears, while steam turbines have but 13 pages, the ones illustrated being the De Laval, Parsons, Zoelly, and Riedler-Stumpf; the recent application of this motor to steamships has not yet been embodied in the book 310 pages. Machines, including among others, metal and wood-working machinery, with 30 pages; also hoisting and conveying machinery, which is treated very fully, and pumps; 210 pages. Index, 12 pages.

Volume II. Surveying, 48. Building Construction, 53. Heating and Ventilation, 33. Water Supply, 33. Sewerage, 17. Highway Building, 38. Statics of Structures, 96. Bridge Construction, 38. Naval Architecture and Engineering, 138. Railroads, 202. Metallurgy of Iron, 22. Electrotechnics, 134. Gas Making, 22. Appendix, in which we find much information with comparative tables regarding the units employed in various countries all over the world, monetary units being included, and also German laws and regulations regarding patents; 40 pages. Index, 12.

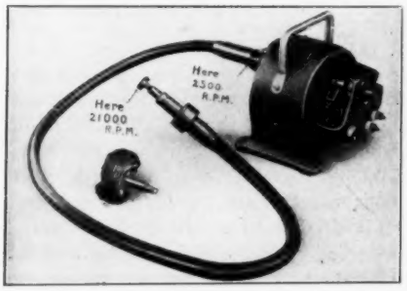
It is, from one point of view, a disadvantage to have one's handbook divided into two; however, since one volume is much larger than the other, one should soon acquire the habit of at once placing the hand upon the volume desired.

The 1906 "Year-book" of the American Society of Refrigerating Engineers contains a list of the officers and members, and the constitution and by-laws. A copy may be obtained by anyone interested by addressing Wm. H. Ross, Secretary, Suite 806, No. 258 Broadway, New York City.

New Tools and Machine Shop Appliances.

AN ELECTRICAL GRINDER.

The illustration shows an electrical motor which drives an emery wheel through a flexible shaft provided at the outer end with a multiplying device for increasing the speed between the motor and emery wheel spindle 8½ to 1. Thus a motor making 2500 r.p.m. would give a spindle speed of 21,000.



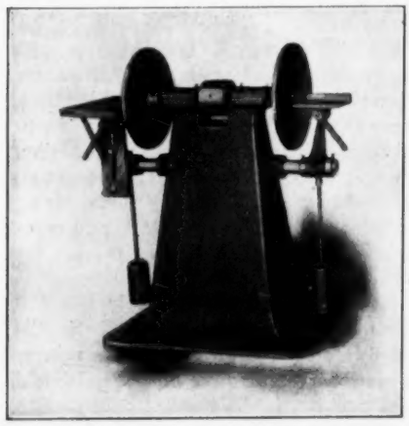
AN ELECTRIC GRINDER.

A number of uses suggest themselves for such an outfit: Dies that have warped in hardening may be ground; wrinkles in drop dies may be ground out in place; it may be used in the lathe for external or internal work; metal signs or the brass work on automobiles, etc., may be ground *in situ*. Wherever current is obtainable the rig can be used for grinding either with or without the multiplying device.

It is made by the Coates Clipper Manufacturing Company, Worcester, Mass.

A DISK GRINDER.

The illustration shows a double ended 18-inch disk grinder. The rest at one end is adjustable to an angle and held by a binder. On the other end of the machine



A DISK GRINDER.

is a swinging table; this also is adjustable to an angle. The spindle runs in babbitt boxes 2 inches diameter by 8 inches long, provided with thrust collars to take up the thrust. The pulley is 4¾ inches wide. The floor space required is 36x30 inches; distance from the floor to the center of the spindle 40 inches. This machine is built by the Phœnix Iron Works Corporation, Hartford, Conn.

A PIPE CUTTER.

The illustration shows a pipe cutter which possesses some novel features. The main body of the tool consists of a pair of V-shaped arms pivoted at one end. At the other end are a pair of V-shaped projections which embrace the pipe. These are held in contact with the pipe by a hook-bolt shown at the extreme left of the illustration. The hook-bolt has a series of notches or hooks milled in one side as shown. The notches accommodate it to the various sizes of pipe within the capacity of the cutter. The hook bolt fits a milled slot in the ends and keeps the V's and cutters in alinement. The thumb nut is to give the desired tension. As will be seen the cutters are circular in form; in the tool shown they are 0.05 inch thick, and 2¾ inches diameter, which will permit quite a lot of regrinding before they are used up. The cutting edge of these cutters is not square, but angular, the long side of the one cutter cuts one side of the groove while the long side of the other cutter cuts the other side of the groove. This arrangement makes the groove wider than the chips and prevents "digging in" and breakage. The cutters are mounted on a pair of levers pivoted on the long arms as shown. Behind the projection approximately mid-way along each of the levers is a heavy coiled spring connecting the levers with the main arms. These springs do the feeding. In front of each of the cutters is a small shoe which is secured to the lever by two screws, these shoes are set slightly lower than the cutting edges of the cutters and regulate the depth of cut. Behind each of the cutters is a cam so that the cutters may be lifted out of contact with the pipe.

In operation, the tool is placed on the pipe; the cutters are thrown into operation and by using the long arms as a lever the tool is revolved around the pipe till it is cut off.

This tool is the invention of W. W. Vosper, who invented the Toledo pipe-threading machine. It is made by him at 611 Osborne street, Sandusky, Ohio.

A PIPE CUTTER.

Deterioration of Metals under the Action of Sea Water.

We find in the report on the Progress of Metallography of the International Association for Testing Materials the following regarding the effect of sea water on metals, which action was the subject of some discussion in our columns:

Chemical deterioration. In constructions, the mechanical deteriorations are usually more rapid than the chemical ones, hence the legitimate preponderance of mechanical tests. But this is not always the case. In naval constructions, for instance, certain portions which are in contact with sea water may corrode rapidly.

J. T. Milton and W. J. Larke have gone into the questions of chemical deterioration and of the choice of alloys to oppose them. They have borrowed the assistance of metallography with success.

As is well known, the gray phosphoric cast iron is strongly attacked by sea water, which converts it into a spongy mass without any consistency. The alteration originates from the graphite and leaves the phosphoric eutectic* alone.

In the tubes and plates of the condenser, which are always in contact with sea water, the Müntz metal becomes more and more impoverished in zinc. Adopting the ideas of Prof. Arnold, the authors think that the two constitutents of the alloy form galvanic elements of which the one loses zinc until the poles are reversed. The second constituent then commences to give off zinc in its turn; thus there are two stages in the destruction. The metal remains yellow during the first stage and becomes red during the second one; at the end it is only a mixture of copper and

*A substance fusing readily as compared with the elements contained in it.

zinc oxide. This is confirmed by microscopic examination.

The addition of a little tin to the alloys acts as a very marked preservative, as already shown by the trials instituted by Lloyd's Register.

Gun metal resists sea water better than brass. The change appears to begin with the envelopes of the crystallites, which, while remaining metallic, change to a darker hue.

Besides uniform deterioration, rapid local perforations have also been noticed, for instance, in condenser tubes made of homogeneous brass. These perforations may be due, either to local accumulations of impurities, or to mechanical erosions starting from irregularities of the surface. It is important that the surfaces should be well polished.

The authors also recommend, for metals and alloys exposed to sea water, an insulation as complete as possible of all the electrical cables in the neighborhood.

Marine Work During 1905.

During the year 1905 there were launched from the various shipyards in the United States 39 vessels, of 177,385 gross or 125,958 net tonnage, at a total value of $39,879,300, which had been commenced in 1904 but which had taken more than a year to build. The total number of vessels launched during the year was 2245, as against 2087 in 1900. The gross tonnage showed a decrease from 687,681 to 645,320 tons in the five years, and from 542,839 to 539,508 tons in the net tonnage, on the other hand there has been an increase in the value of these boats from $1,972,825 to $58,452,629. In 1900 the number of small boats launched, under 5 tons was 15,448 at a total value of $1,-972,825; in 1905 the number had increased to 26,981 at $3,148,834.

The number of establishments engaged in shipbuilding has decreased from 1116 in 1900 to 1097 in 1905, or 1.7 per cent.; on the other hand the capital invested has been increased from $77,362,701 to $121,-625,250, or 57.2 per cent. This was exclusive of 20 establishments with an output of $657,342 but who were engaged primarily in the manufacturing of other products, the shipbuilding industry being but a side issue, so to speak.

The total value of the year's work was $82,769,239 as compared with a total value of $74,578,158 in 1900, an increase of 11 per cent. This amount included rigging and repair work.

On April 28 the Milan international exhibition was opened, the king and queen of Italy being present. The Simplon tunnel, is, of course, given special prominence. The exhibition has a reproduction of the ends of the tunnel, and in a special pavilion the progress of the work is represented by means of a cinematograph.

The American Palace Car.

A car which, though convertible with great ease and small expenditure of time from a sleeping car to a chair car or a dining car, and yet which is not at all handicapped in the fulfilling of any one of these functions, is an invention which has been for several months past under demonstration on the railroads. One of these cars, the "Columbia," has been running on lines near the Atlantic coast. The first peculiarity noticeable about this car, as one stands outside of it, is the long box suspended beneath the body, extending from truck to truck, made so that its outer side is flush with, and is practically a prolongation downward of, the side of the car body. This box is duplicated on the other side of the car. Upon entering the car when it is arranged, say, as a chair car, one sees no sign of berths, no row of small windows, no fixed seats; but instead it is a typical chair car, with a smooth carpeted floor, windows of ample size, giving a pleasing outlook, and portable upholstered wicker chairs. And yet the porter can make up a section with two berths complete and ready for occupancy in two or three minutes. He clears the wicker chairs off a portion of the floor, lifts up the latter and its attached carpet so as to form the ends for the section, completed by sliding in head boards, and on the ends are carried guides, pulleys and cables by which the berths are lifted from the dust-proof (but ventilated) box beneath the car. The bottom of the box contains drums of large diameter and narrow face on a vertical axis, and upon these drums are wound the steel bands which run up and over pulleys and support the berths. The porter is provided with a long brace-like socket wrench, which he inserts into a hole in the floor of the car without having to stoop, and by turning a vertical shaft the drum is caused to revolve and the berth is hoisted to the desired hight. The lower berth is then brought up a little too high, so as to permit of stowing away the chairs in the box, and then lowered again to its proper position; the berths are locked and the bedding put in place, the curtain hung, etc. It is all done in about the time it takes to describe it. It is probable that the upper berths of these cars will be nearly or quite as popular as the lower ones, since the occupant has the regulation of his own window and blinds or window shades independently of the occupant of the lower berth, and has also good ventilation. The "Columbia" is also provided with a disappearing brass bedstead section, a galley for the cook and an observation compartment. The change to a dining car is made with equal rapidity, and the result is equally satisfactory. These statements are made from personal observation and are quite unbiased.

This particular car is lighted by acetylene gas, though of course this has nothing to do with the convertible feature. Besides the saving of time and annoyance to passengers from making up berths it has the great advantage of being a sleeping car at night and a chair car or diner in the daytime—three cars in one—thus effecting a great saving in car mileage, locomotive power, cost of crew, lighting, yard room, etc. Excellent sanitation and low center of gravity are also claimed for this car.

The invention possesses considerable adaptability; it has a possible application to ships, and especially war vessels—and, perhaps, to the proverbial "Harlem flat." It has already been applied to a handsome hospital car built for the Southern Pacific Railroad Company, under the direction of its chief surgeon. The Southern Pacific car is 67 feet long over end sills, 75 feet 11¼ inches long over platforms and weighs 122,550 pounds; it has several apartments, including a hospital ward and an operating and dressing room, having together six sections of two berths each, made to rise and fall as described.

An invitation was extended to the members of the Detroit Engineering Society by the American Blower Company to visit its plant on May 25, which was responded to heartily by the members of the society. They were afterward entertained by the same company at a "beefsteak supper" at the Fellowcraft Club. A regular meeting was then held, at which F. R. Still read a paper on "Small Vertical High-speed Self-oiling Engines." It is the idea of the American Blower Company that other manufacturers will extend similar courtesies to the engineers of the city, thus enabling the latter to have the benefit of visits to the various manufacturing plants.

The superintendent of the Allan Line is reported to have said, "The next turbine we build will have cranks and connecting rods."

Personal.

Lewis H. Morgan, general manager of the Ridgway Machine Tool Company, of Ridgway, Penn., has sailed for Europe.

Prof. F. R. Hutton, secretary of the A. S. M. E., has recently been confined to the house for several days as a result of severe burning of both his hands in an automobile fire.

James A. Pratt, for the past five years instructor in machine work and drawing at the State School for Boys, Howard, R. I., has been appointed assistant instructor in machine-shop practice at Pratt Institute, Brooklyn, N. Y.

M. C. Krarup, of 1168 Euclid avenue, Cleveland, O., has finished his engagement as introductory editor of *The Power Wagon* and will resume his line of

special work in commercial and technical journalism.

Charles G. Renold, son of Hans Renold, of Manchester, England, is here for the purpose of graduating at Cornell University, where he has taken the course in mechanical engineering. He has been at home in the works during the past year, but was ahead with his school work when he left and has gone on with it, so that he graduated with his class.

At the celebration of the 75th anniversary of the Koeniglich Preussische Technische Hochschule, of Hanover, Germany, the honorary degree of Doctor of Engineering was conferred on Ernst Koerting, member of the well-known firm of Gebr. Koerting, A. G. Koertingsdorf, Hanover, for his scientific researches and discoveries in gas engines, and other important branches of engineering. Dr. Koerting lives in Pegli, Italy. He is interested in a number of enterprises in the United States, among these the De La Vergne Machine Company, of New York, as well as the Schütte-Koerting Company, of Philadelphia.

Business Items.

The Krieger & Nelson Tool Company, successors to the Grant-Nelson Tool Company, have located at Grand Rapids, Wisconsin, and not at Grand Rapids, Mich., as noted in this column in a former issue.

The Whitney Manufacturing Company, of Hartford, Conn., has decided to erect a new factory, and in furtherance of its plans has purchased a fine piece of manufacturing property in that city. This property, which is located on the N. Y., N. H. & H. R. R. tracks, has a frontage of 450 feet on Hamilton street and of 560 feet on Bartholomew avenue. The building will be of modern reinforced concrete and fireproof construction, and the main factory will be 228 feet long by 61 feet wide, four stories high, which, with a single-story extension building about 64 feet square, will give a floor space of about 62,000 square feet. Operations will be begun immediately and the company will be located in its new quarters by November 1.

Manufacturers.

The Ballard (Wash.) Drop Forge Company is building an addition.

The Lincoln (Neb.) Traction Company will erect a new power house.

The Warden Tool Company, Cleveland, O., will build a $40,000 plant.

The Narragansett Machine Company, Pawtucket, R. I., is building a large addition.

The plant of the Wilson Aluminum Company, Kanawha Falls, W. Va., is to be enlarged.

The Union Hardware Company, Torrington, Conn., is erecting additions at a cost of $30,000.

The Canadian Bronze Company, Montreal, Canada, will erect a new factory to cost $20,000.

The International Harvester Company will make additions to its plant in Milwaukee, Wisconsin.

The Telluride Power Company, of Provo, Utah, will install another power plant on Utah Lake.

The West Jersey & Seashore Railroad is erecting a $40,000 power house at Somers Point, N. J.

The Merchants and Manufacturers Association, of Rome, Ga., will erect a $15,000 canning factory.

The Barnard & Leas Manufacturing Co., Rock Island, Ill., contemplates the erection of a new foundry.

Fire destroyed the plant of the Sanford (N. C.) Sash and Blind Company's plant. It will be rebuilt.

It is reported that H. C. Frick, of Pittsburg, Pa., has selected a site in Camden, N. J., for a steel plant.

The Cleveland (Ohio) Twist Drill Company has taken out a building permit for a new machine shop.

The plant of the Michigan Pipe Company at Bay City, Mich., which burned a short time ago, is being rebuilt.

Adell Bros. Manufacturing Company, sheet metal novelties, Orange, Mass., will build an addition to its plant.

T. B. Wood's Sons Company, engineers, machinists and founders, Chambersburg, Penn., will build a new plant.

The J. P. Symons Company, Centralia, Wash., will at once rebuild its foundry, recently destroyed by fire.

The Cranbrook (B. C.) Electric Light and Power Company will establish a power house on the St. Mary's River.

The Van Briggle Pottery Company, Colorado Springs, Colo., is looking for a site on which to build a larger plant.

Trade Catalogs.

Jacob Neuert, Chicago, Ill. Booklet illustrating automatic pipe-bending machine. 4½x6½, paper.

Chapman Portable Forge and Engine Works, Marcellus, Mich. Catalog of gas and gasolene engines. Illustrated, 3½x6, paper.

Wellman-Seaver-Morgan Company, Cleveland, Ohio. Circular No. H-O 8, describing self-contained geared hoists. Illustrated, 6x9, pp. 31, paper.

J. H. Williams & Co., 150 Hamilton avenue, Brooklyn, N. Y. 1906 catalog of drop-forged specialties. Illustrated, 5x7½, pp. 113, paper.

The Piqua Foundry and Machine Company, Piqua, Ohio. Bulletin No. 10, describing "The Piqua" Positive Blowers. Illustrated, 6x9, pp. 12, paper.

The Green Fuel Economizer Company, Matteawan, N. Y. Bulletin No. 104, describing Green planing-mill exhausters. Illustrated, 3½x6, pp. 16, paper.

The Owen Machine Tool Company, Springfield, Ohio. Catalog B, describing universal, plain and duplex milling machines. Illustrated, 6x9, pp. 55, paper.

Dodge & Day, Philadelphia, Pa. Pamphlet No. 15, describing some industrial power plants installed by this company. Illustrated, 6½x9½, pp. 7, paper.

Diehl Manufacturing Company, Elizabethport, N. J. Bulletin No. 150, describing types "F" and "FC" motors and generators. Illustrated, 6x9, pp. 20, paper.

Baldwin Locomotive Works, Philadelphia, Pa. Record of Recent Construction, No. 35, which describes Walschaert's valve gear. Illustrated, 6x9, pp. 27, paper.

Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass. Bulletin No. 607, superseding No. 332, describing "G. I." hanger boards for multiple arc lamps.

Rockwell Engineering Company, 26 Cortlandt St., New York. Circulars illustrating and describing Rockwell double chamber metal-melting furnace and oil burners.

Crocker-Wheeler Company, Ampere, N. J. Bulletin No. 65, illustrating and describing core-type transformers for high-tension power transmission. 7½x10, pp. 8, paper.

The Safety Emery Wheel Company, Springfield, Ohio. Bulletin describing automatic open-side surface grinder and No. 140 planer surfacer. Illustrated, 6x9, pp. 8, paper.

The Hoosier Forge Company, Connersville, Ind. Catalog of the Vulcan Junior tuyere iron or fire bed for blacksmith and forge shops. Illustrated, 3½x6½, pp. 7, paper.

E. Leonard & Sons, London, Canada. Catalog of Leonard-Corliss engines, stationary return tubular and water-tube boilers, condensers, etc. Illustrated, 7x9½, pp. 36, paper.

Ingersoll-Rand Company, Pneumatic Tool Department, 11 Broadway, New York. Bulletin No. 2006, describing "Imperial" pneumatic hammers. Illustrated, 6x9, pp. 16, paper.

J. J. McCabe, 14 Dey street, New York. Catalog of "2 in 1" double-spindle lathes. This is attractively gotten up and contains very fine half-tone illustrations. 7x10, pp. 40, paper.

L. Best & Co., 45 Vesey St., New York. Catalog and price list of emery wheels, emery grinding machinery, polishing supplies and buffing machinery. Illustrated, 6x9, pp. 96, paper.

Gardner Machine Company, Beloit, Wis. Binder containing bulletins illustrating and describing "Gardner's Improved" disk grinders, band-polishing wheels, disk-wheel circles, etc.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Patented machines built to order. Interstate Machinery Co., Troy, N. Y.

Wire and sheet metal working machinery and tools. Emmons Collins, Chicago, Ill.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Good tool or machine specialty wanted. Give full particulars. Automatic, 660, AM. M.

Light and fine machinery to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Gas engines designed to order. Marine and automobile work a specialty. H. L. Towle, 150 Nassau street, New York.

Special machinery to order. Inventions developed. Geo. M. Mayer, M. E., 1131 Monadnock Block, Chicago, Ill.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—A good second-hand radial drill with about a four-foot arm. Address the K. C. Hay Press Co., Kansas City, Mo.

Wanted—To complete volume, AMERICAN MACHINIST of April 13, 1905. Will pay premium. Box 613, AMERICAN MACHINIST.

Punch press wanted. Bed opening about 22 in. Also No. 1 Universal miller. E. B. Abbott, 2912 Central avenue, S. E., Cleveland, Ohio.

Work wanted—We are thoroughly equipped for building fine automatic machinery. The G. N. McKibbin Manufacturing Co., South Norwalk, Conn.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear and Machine Co., 141 Oxford street, Philadelphia, Pa.

Offers, with catalog, desired for machinery, wanted for complete bolt, nut and rivet plants. Reply to Box 777 Root, 200 Greene street, New York.

Glass test bars 5/16x1½x7 inches long, $3.50. Knife-edge squares and straight edges. All tools guaranteed. "Scotty," Box 670, AMERICAN MACHINIST.

Wanted—Worms, spirals and screws to cut. We are equipped with special machines for milling these parts. Get our prices on doing some of your difficult jobs. Parsons & Lane, Sodus, N. Y.

Wanted to manufacture in Canada: Sheet-metal stampings, hardware specialties, strip steel and wire forming. Ryall Screw and Specialty Company, 1570 St. Lawrence street, Montreal.

Wanted to purchase—Cleveland automatic screw machines with plain plungers and full Cleveland automatics; also 2-inch hollow spindle capstan lathes and larger. State full particulars regarding the condition of the machines and lowest price for same to the Auto Machinery Company, Ltd., Coventry, England.

Tool catalog No. 22, 950 pages bound in cloth. Greatest small-tool catalog ever published. Will be sent post-paid on receipt of $1. Money paid for catalog refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton street, New York City.

PROPOSALS will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until **10 o'clock a. m.,** June 19, 1906, and publicly opened immediately thereafter, to furnish at the navy-yard, New York, N. Y., a quantity of machine tools, as follows: **Sch. 562**: Metal saw.—**Sch. 564**: Trimming press, steam hammer, wood lathe, rip-saw.—**Sch. 565**: Pipe bender. Applications for proposals should designate the schedules desired by number. Blank proposals will be furnished upon application to the navy pay office, New York, N. Y., or to the Bureau. H. T. B. HARRIS, *Paymaster-General U. S. N.* 5-12-06

For Sale.

For Sale—Foundry, wood and iron machine shops, Albion, N. Y., Box 74.

For Sale—Excellent machine-shop building, with power, in Philadelphia; 60x90 feet, three stories, solid ground floor. Box 545; AMERICAN MACHINIST.

For Sale—Machinery-manufacturing plant, including machinery, tools, jigs and good will. Doing a business of from $100,000 to $150,000 per year; can secure buildings with water power at very reasonable rent for term of years. Address J., Box 678, AMER. MACH.

Business Opportunities.

Concern to make direct-reading gas-meter index and to buy part interest in same. Box 655, AMERICAN MACHINIST.

Wanted—Engineer or draftsman as partner and eventual successor to engineer's office in middle West. Investment up to $3000 required. Box 666, AMERICAN MACHINIST.

I have manufacturing experience, an exceptionally favorable site and cheap power. I want a light manufacturing business to utilize them. P. O. Box 2034, New York City.

Wanted—Thorough business party to take an interest in, or buy a going foundry, and small machine shop, now receiving orders for five tons castings daily. Address L, 1918 Morris Ave., Birmingham, Ala.

Wants.

Situation and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

GEORGIA.

Position as superintendent or general foreman on engines, air compressors, general machine-shop work. Box 647, AMER. MACH.

INDIANA.

Superintendent wishes to make a change; power-transmission line preferred; fully acquainted with modern shop practice; can reduce cost and systematize plant. Box 640, AMERICAN MACHINIST.

NEW JERSEY.

Mechanical draftsman wishes position. Box 671, AMERICAN MACHINIST.

Engineer draftsman, 30 years, desires change, 12 years' experience in marine boilers, engines, centrifugal pumps, some shipbuilding, and truss construction. Box 668, AM. MACH.

NEW YORK.

Responsible position in steam turbine manufacture; several years' experience. Box 631, AMERICAN MACHINIST.

General foreman; 20 years' experience automobiles and machinery, desires change. Box 657, AMERICAN MACHINIST.

By young man, position as detailer, some designing. Mechanical. Four years' experience. Box 663, AMERICAN MACHINIST.

Master mechanic, designer, competent to build, improve special automatic machinery; reliable estimator. Box 685, AMER. MACH.

First-class mechanical draftsman with many years' experience in shop and drawing room wants position. Answer to "A. B.," 661, AMERICAN MACHINIST.

Turbine erector, experienced, now employed, desires change; hold chief engineer's (marine) license; seven years' sea service; first-class references. Box 679, AMERICAN MACHINIST.

All-around mechanical draftsman desires change, 12 years' experience, 3 years in America. In or around New York preferred. Good reference. Box 669, AMERICAN MACH.

General foreman, successful in producing first-class work at satisfactory cost, varied experience in high-grade machinery, master machinist, desires change. Box 675, AM. M.

Wanted—Position in publicity department of manufacturing establishment in Eastern territory; experienced in the preparation of copy and with the details of cut making and printing. Box 681, AMERICAN MACHINIST.

Mechanical engineer, technical graduate, 7 years' experience in pumping machinery and power house construction desires position as assistant engineer with contractor, consulting engineer or manufacturing company. Box 677, AMERICAN MACHINIST.

Expert tool designer and master mechanic desires change; age 36; high-grade and accurate work, jigs, fixtures, tools and automatic machinery for duplicate parts; A-1 references; position as superintendent preferred. Box 684, AMERICAN MACHINIST.

An experienced designing draftsman and expert machinist with necessary experience and ability to successfully fill position as superintendent, chief engineer or chief draftsman, wishes leading position with progressive firm. Fourteen years' varied experience. Now employed. Box 662, AMERICAN MACHINIST.

Superintendency or general foremanship by a hustling young mechanic; good handler of men and work; clever designer of jigs and special appliances; successful department organizer and systemizer; specially experienced in heavy machinery manufacturing; good cause for desired change; will give past and present employers as references. Box 683, AMERICAN MACHINIST.

PENNSYLVANIA.

Mechanical engineer and superintendent, 15 years' experience in general line such as machine tools, cranes, hydraulic machinery, etc., wants to change. Can design and produce good work cheaply. Box 656, AM. M.

Wanted—Position as superintendent by man of character and ability; has had wide experience and is conversant with modern shop and foundry methods; shop management and organization a specialty; best of references. Box 648, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Competent superintendent would like to change; experienced toolmaker, tool designer, master mechanic and superintendent; 16 years' experience in the commercial manufacturing of small and medium interchangeable machinery; position preferred with some typewriter, adding machine or automobile manufacturing company; a cost reducer. Box 650, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Mouldmaker—One thoroughly familiar with work required for rubber factory; must be able to make his own tools and jigs. Write, stating experience and wages expected, to Mr. Whyte, P. O. Box 2267, Montreal, Canada.

CONNECTICUT.

Wanted—Several competent all-around jobbing machinists. The Eastern Machinery Co., New Haven, Conn.

Machinists—We have positions for good floor and bench hands. Steady work and good wages. Printing-press work. Address The Brown Cotton Gin Co., New London, Conn.

We are now located in our new buildings, with an up-to-date equipment, and solicit applications from first-class toolmakers, diemakers and machinists for high-grade work. Apply, stating age and experience, to The Yale & Towne Mfg. Co., Stamford, Conn.

ILLINOIS.

Wanted—Man thoroughly competent to take entire charge of inspection in modern factory manufacturing automatic machinery requiring small, accurate, interchangeable parts; only men with good experience and A No. 1 records will be considered; give age, salary and references. Box 682, AMERICAN MACHINIST.

Wanted, draftsmen—We want capable draftsmen of either electrical, mechanical or general experience. If you would like to change your position or its location, write and tell us about the character and extent of your work. Address, giving full particulars, to Western Electric Company, Dept. No. 29, Chicago.

MASSACHUSETTS.

Machinists—We are in need of first-class men with experience on steam engine work, good pay and steady work, no labor trouble. C. H. Brown Engine Co., Fitchburg, Mass.

Wanted—Cost clerk; experienced, capable man as assistant; must have thorough knowledge of cost finding in machinery line; pumping machinery preferred, though not essential; state age, experience and compensation expected. Box 680, AMERICAN MACHINIST.

MICHIGAN.

Turret-lathe operator wanted for 21-inch American turret lathe; steady employment to man who can rush out the work. Northern Engineering Works, Detroit, Mich.

Wanted—Young man about 30, of experience in shop practice and supervision preferred. Capable of designing high-class machine tools, screw machines, turrets and boring tools. This is a chance for some one who is willing to grow and remain with a "sure thing." Address Tools, 664, AMER. MACH.

MINNESOTA.

Wanted—First-class machinists, moulders and patternmakers, also structural template makers and structural iron workers. We are daily increasing our business and will consider applications from competent mechanics in the above branches of our business. Address, with references, Minneapolis Steel and Machinery Co., Minneapolis, Minn.

NEW JERSEY.

Wanted—Mechanical electrical draftsmen; only first-class men need apply. Box 508, AMERICAN MACHINIST.

Wanted—Men experienced on installing and overhauling marine gasolene engines. Good pay and steady work. Box 659, AMER. MACH.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J

Expert drop-forge man for high-class automobile forgings, also drop-forge diemaker. Good pay and permanent positions for the right men. Give present employment and wages expected. All communications confidential. Box 667, AMERICAN MACHINIST.

Foreman to take entire charge of shop manufacturing speed-meters in large lots. To a man who is now employed in similar work, and making a success we can offer a permanent position at a good salary. State present position and pay expected. All communications treated confidentially. Motor Car Specialty Co., Trenton N. J.

Factory superintendent for a manufacturing plant employing about 130 hands. Must be energetic, tactful, a good executive, capable of handling help to advantage, and accustomed to devise labor-saving methods. Plant is located at Newark, New Jersey. State full experience, age, present occupation, and salary desired. Address Box 676, AMERICAN MACHINIST.

Wanted—Office manager by large portland cement company located near Easton, Pa. Must be first-class accountant and have had considerable practical experience with manufacturing books, and be able to handle office employees to best advantage; first-class opportunity for able man; good salary paid. Give full particulars as to experience. Address, "Portland Cement," 674, AMER. MACH.

NEW YORK.

Wanted—Experienced draftsmen, toolmakers and machinists. Give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

Wanted—Two first-class draftsmen, accustomed to jig, gage and small fixtures for

the production of interchangeable and duplicate parts. "Superintendent," 658 AM. MACH.

Ingersoll-Rand Co., Painted Post, N. Y., is rapidly increasing force and invites applications from machinists for all branches of the trade. Excellent opportunity is offered energetic, capable young men. Box 641, AM. M.

We are permanently increasing our capacity and require the services of 20 mechanical draftsmen for detail work. Attractive positions to suitable men. Location in New York City. Address, stating age, experience and salary expected, Box 627, AMER. MACHINIST.

Wanted—Machinist with road experience as salesman, calling on all iron-working plants. Knowledge of turrets, automatics and threading machines, cutting tools and dies essential. State age, experience, salary expected and references. Box 618, AM. MACH.

OHIO.

Several first-class draftsmen on detail and assembly drawings; state age, experience and salary. Box 609, AMERICAN MACHINIST.

The National Metal Trades Association can place a few first-class wood patternmakers, toolmakers and all-around machinists. Highest wages and steady employment guaranteed. Address with references, Robert Wuest, Secretary, 1416 Union Trust Bldg., Cincinnati, O.

PENNSYLVANIA.

Wanted—First-class draftsman on mill construction and equipment, technical man preferred. Box 578, AMERICAN MACHINIST.

Wanted—Thoroughly experienced erecting machinists, accustomed to steam engine or compressor work. The Blaisdell Machinery Co., Bradford, Pa.

Wanted—Fifty first-class toolmakers or machinists; good wages to right parties; no labor troubles. Driggs-Seabury Ordnance Corporation, Sharon, Pa.

Wanted in Philadelphia, experienced tool and diemakers familiar with power press work of medium size. Good wages for the right men. Box 665, AMERICAN MACHINIST.

Wanted—First-class instrument and toolmakers; also large machine-tool operators. Address Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

Wanted—A few first-class machinists and toolmakers; also one or two automatic screw-machine operators, for automobile work; steady work guaranteed. Address, giving experience, references and wages desired, The Autocar Company, Ardmore, Pa.

Wanted—A number of mechanical draftsmen; those with experience in electrical apparatus, generators or motors preferred. Only first-class men need apply. Address, Chief Draftsman, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. (P. O. Box 911.)

The Monotype Company maintains a free school for training young machinists to operate its type casting and composing machines. The demand for monotype operators is so great that it receives more applications for places in its school than can be filled. In making selections these qualifications carry most weight; character, common sense, experience with automatic machinery, (or) printing-office experience, or type-foundry experience. Full particulars will be furnished to inquirers who furnish full particulars about themselves. Lanston Monotype Machine Co., 1231 Callowhill St., Philadelphia, Pa.

RHODE ISLAND.

Toolmakers wanted—First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Pierce Mfg. Co., Woonsocket, R. I.

WEST VIRGINIA.

Wanted—Accurate machinist on Marine Engine work. Ward Engineering Works, Charleston, W. Va.

WISCONSIN.

As the result of doubling its new West Allis plant, Allis-Chalmers Co., of Milwaukee, needs more patternmakers, machinists and moulders.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AM. M.

WEST OF MISSISSIPPI.

Wanted—Competent, resourceful mechanics to learn adding-machine repair work. Steady employment in our branch houses after proper course of instruction at factory. Give experience. Box 634, AMERICAN MACHINIST.

Wanted—Good mehanical draftsman, one familiar with machine design, gasolene engines and air compressors preferred. State age, experience, references and salary expected. All communications confidential. Box 673, AMERICAN MACHINIST.

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Safety Emery Wheel Co., Springfield, O.
Star Corundum Wheel Co., Detroit, Mich.
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Aftercoolers, Air

Ingersoll-Rand Co., New York.

Air Lifts

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Alloy, Nickel

Boker & Co., Hermann, N. Y.

Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Arbors

Cochrane-Bly Co., Rochester, N. Y.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Architects

Dodge & Day, Philadelphia, Pa.

Automatic Machinery

Matchless Cigar Lighter Mfg. Co., New York.
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Ball Bearings

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Cleveland Wire Spring Co., Cleveland, O.
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Lyon Metallic Mfg. Co., Chicago, Ill.

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Globe Machine & Stamping Co., Cleveland, O.
Kilbourne & Jacobs Mfg. Co., Columbus, Ohio.

Bars, Boring

Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Elmes Eng. Works, Chas. F., Chicago, Ill.
Krieger-Nelson Tool Co., Grand Rapids, Wis.
Mathews, Hugh, Kansas City, Mo.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.
Underwood & Co., H. B., Philadelphia, Pa.

Bars, Boring Cylinder

Underwood & Co., H. B., Philadelphia, Pa.

Belt Dressing

Cling-Surface Co., Buffalo, N. Y.
Dixon Crucible Co., Jos., Jersey City, N. J.
Shultz Belting Co., St. Louis, Mo.

Belt Filler

Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.

Belting Leather

Main Belting Co., Phila., Pa.
Montgomery & Co., New York.
Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Bending Machinery, Plate

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Niagara Machine & Tool Works, Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toledo Machine & Tool Co., Toledo, O.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Bending Machines, Hydraulic

Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bertsch & Co., Cambridge City, Ind.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa
Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.
National Machy. Co., Tiffin, O.
Niles-Bement-Pond Co., New York.
Swaine Co., Fred. J., St. Louis, Mo.

Bending Tools, Hand

Estep & Dolan, Sandwich, Ill.
Wallace Supply Co., Chicago, Ill.

Bicycle Parts

Standard Welding Co., Cleveland, Ohio.

Blanks, Nut and Screw

Whitman & Barnes Mfg. Co., Chicago, Ill.

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Blowers

American Blower Co., Detroit, Mich.
Am. Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Garden City Fan Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Roth Bros. Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines

Buckeye Engine Co., Salem, O.
General Electric Co., New York

Bollers

Struthers-Wells Co., Warren, Pa

Bolt and Nut Machinery

Acme Machry. Co., Cleveland, O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Brown Co., H. B., Easthampton, Conn.
Detrick & Harvey Mach. Co., Baltimore, Md.
Harrington & Son Co., Edwin, Philadelphia, Pa.
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Lang Co., G. R., Cincinnati, O.
National Machy. Co., Tiffin, O.
Northern Elec. Mfg. Co., Madison, Wis.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Bolt and Nut Machinery
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Machinery Co., Bowling Green, Ohio.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Webster & Perks Tool Co. Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolts, Coupling
Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Bolts and Nuts
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Bone for Case Hardening
Rogers & Hubbard Co., Middletown, Conn.

Books, Mechanical
American School of Correspondence, Chicago, Ill.
Audel & Co., Theo., New York.
Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York.
Sames, C. M., Jersey City, N. J.
Tulley & Co., Henry C., St. Louis, Mo.
Wiley & Sons, Jno., New York.

Boosters
Burke Electric Co., Erie, Pa.
C & C Elec. Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleveland, Ohio.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Stow Mfg. Co., Binghamton, N. Y.
Vandyck Churchill Co., New Yr.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills
American Tool Wks. Co. Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
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Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boxes, Tote
Cleveland Wire Spring Co., Cleveland, O.
Lyon Metallic Mfg. Co., Chicago, Ill.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.

Brackets, Lamp
Standard Welding Co., Cleveland, Ohio.

Brazing Plates
Phillips-Laffitte Co., Phila., Pa.

Broaching Machines
Burr & Sons, Jno. T., Brooklyn, N. Y.

Broker, Machinery
Warner, C. S., Niagara Falls, Ont.

Bulldozers
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
National Machy. Co., Tiffin, O.
Prentiss Tool & Supply Co., New York.
Toledo Machine & Tool Co., Toledo, Ohio.

Burners, Oil
Tate, Jones & Co., Pittsburg, Pa.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.

Calipers
Athol Machine Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Mass. Tool Co., Greenfield, Mass.
Montgomery & Co., New York.
Slocomb Co., J. T., Providence, R. I.
Smith Co., E. G., Columbia, Pa.
Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Works, Boston, Mass.

Carborundum
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Case Hardening
Rogers & Hubbard Co., Middletown, Conn.

Castings, Brass and Bronze
Lumen Bearing Co., Buffalo, N. Y.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Fuchs & Lang Mfg. Co., New York
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.
U. S. Foundry & Sales Co., South Norwalk, Conn.

Castings, Motor
Brush & Hudson, Brooklyn, N. Y.
Harrison, H. H., St. Paul, Minn.
Steffey Mfg. Co., Phila., Pa.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
National Machine Co., Hartford, Conn.

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Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
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American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
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Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
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Cushman Chuck Co. Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Montgomery & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Westcott Chuck Co., Oneida, N. Y.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Horton & Son Co., The E., Windsor Locks, Conn.
Montgomery & Co., New York.
Niles-Bement-Pond Co., New York.
Oneida Natl. Chuck Co., Oneida, N. Y.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.

Chucks, Split
Hardinge Bros., Chicago, Ill.
Rivett Lathe Mfg. Co., Boston, Mass.
Westcott Chuck Co., Oneida, N. Y.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
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Billings & Spencer Co., Hartford, Conn.

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Cresson Co., Geo. V., Phila., Pa.
Double Friction Coil Clutch Co., Chicago, Ill.
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Johnston Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
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Advance Mfg. Co., Kalamazoo, Mich.

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Dixon Crucible Co., Jos., Jersey, City, N. J.

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Blaisdell Machinery Co., Bradford, Pa.
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Bury Compressor Co., Erie, Pa.
Curtis & Co., Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
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Ingersoll-Rand Co., New York.

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Evans Friction Cone Co., Boston, Mass.

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Long & Allstatter Co., Hamilton, Ohio.
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Wright, Harold A., New York.

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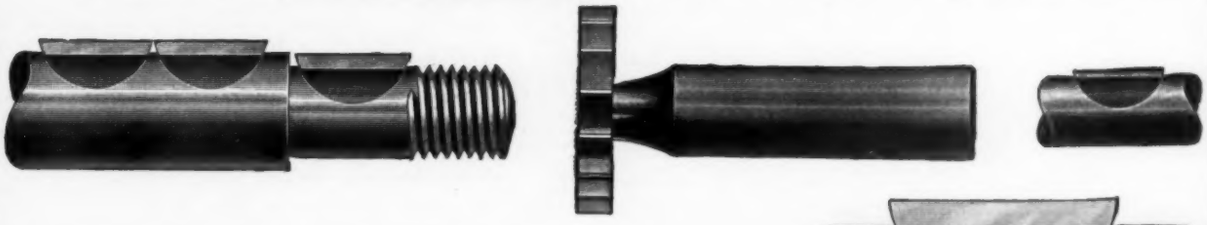

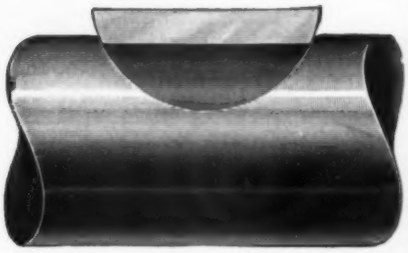

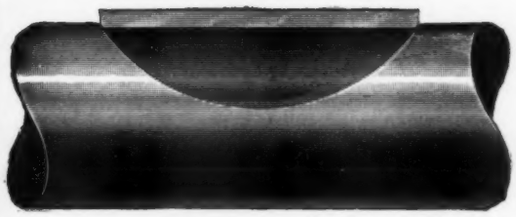

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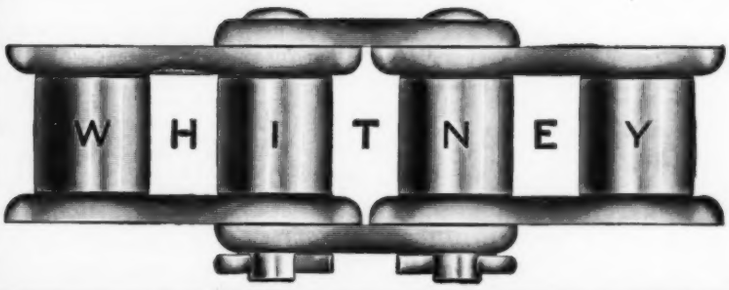

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Kent & Co., Edwin R., Chicago, Ill.
Marchant, Geo. F., Chicago, Ill.
Niagara Machine & Tool Works, Buffalo, N. Y.
Swaine Co., Fred. J., St. Louis, Mo.
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Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O.
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Mueller Mach. Tool Co., Cin., O.
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Prentiss Tool & Supply Co., New York.
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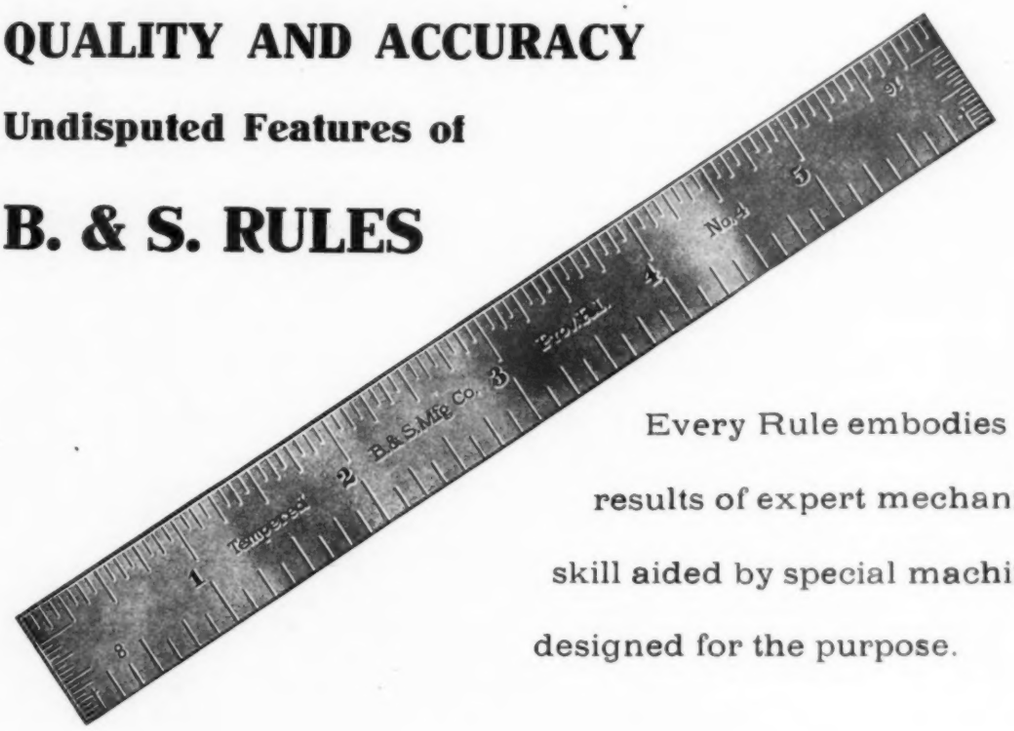

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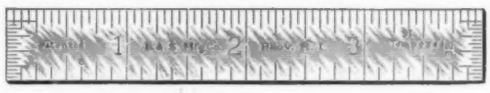

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Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Stow Mfg. Co., Binghamton, N. Y.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y
Burke Machinery Co., Cleveland, Ohio.
Ingersoll-Rand Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
National Machinery Co., Tiffin, Ohio.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
Lang Co., G. R., Cincinnati, O.
Monarch Tool Works, St. Louis, Mo.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Baldwin Steel Co., New York.
Boker & Co., Hermann, N. Y.
Crescent Forgings Co., Oakmont, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Adams Co., Dubuque, Iowa.
Byram & Co., Inc., Detroit, Mich.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers
Sturtevant Co., B. F., Hyde Park, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Furnaces, Enameling
American Gas Furnace Co., N. Y.

Furnaces, Gas
American Gas Furnace Co., N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Obermayer Co., S., Cincinnati, O.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furniture, Machine Shop
Hart & Cooley Co., New Britain, Conn.
Manufacturing Equip. & Engineering Co., E. Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Boston, Mass.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Mass. Tool Co., Greenfield, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

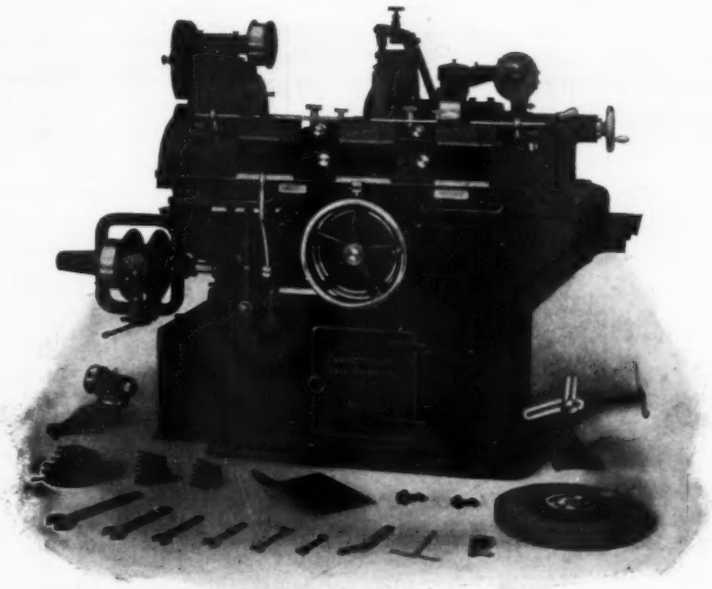
Gages, Steam
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., Ohio.
Bilgram, Hugo, Philadelphia, Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Machine Co., Hartford, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Matchless Cigar Lighter Mfg. Co., New York.
Morse, Williams & Co., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sloan & Chace Mfg. Co., Newark, N. J.
Turley, Harvey G., St. Louis, Mo.
Walcott & Son, Geo. D., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

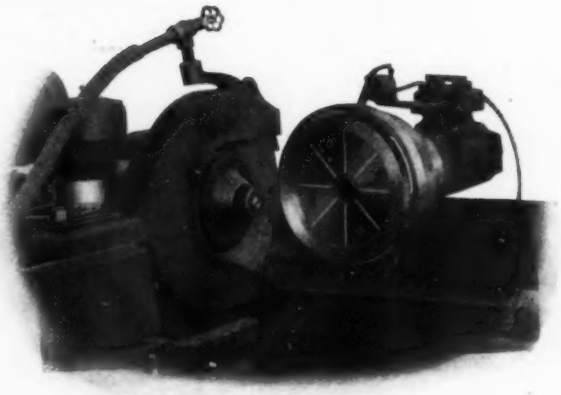
Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
James, D. O., Chicago, Ill.
Morse, Williams & Co., Phila., Pa.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Turley, Harvey G., St. Louis, Mo.

A Sample



Landis No. 22 Grinding Machine



Magnetic Chuck

Five Minutes for Each Piston.

Here are fifty-nine Automobile Gas Engine Pistons which were ground on the Landis No. 22 Plain Grinding Machine. They are 4½" diameter, 5½" long, $\frac{1}{32}$" diameter removed. Average time 5 minutes.

This is proof of what we are claiming for this No. 22, that it is the most profitable machine to be had for automobile manufacturers. It is especially adapted to the finishing of pistons.

In Landis plain machines the

Grinding Wheel Traverses,

not the work, which feature insures accuracy at points of reversing, constant lubrication of the ways which reduces wear to the minimum.

The geared headstock for driving the work and the instantaneous variable speed traverse device are commendable features.

Our Magnetic Chuck Headstock is specially adapted to grinding the sides of Piston Rings.

It is also suitable for all such work as grinding the sides of plates, saws, milling cutters, washers, etc. It is driven by a feed pulley on the spindle which is located back of chuck next to bearing in headstock. We are particularly anxious to get in communication with automobile builders for we know that we have the grinding machines that best meet their requirements. Landis machines are not only very rapid producers, but they are accurate to a quarter of one-thousandth inch.

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VanDorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Molded

Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cin., O.
Philadelphia Gear Wks., Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Rawhide

Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., The, Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.

Gears, Worm

Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
James, D. O., Chicago, Ill.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittburg, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Generating Sets

Burke Electric Co., Erie, Pa.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.
VanDorn & Dutton, Cleveland, Ohio.
Walcott & Son, Geo. D., Jackson, Mich.

Generators, Gas

American Gas Furnace Co., New York.

Gibs

Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite

Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Automatic Knife

Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center

Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock

Windsor Mach. Co, Windsor, Vt.

Grinders, Cutter

Bath Grinder Co., Fitchburg, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, Ohio.
Crocker-Wheeler Co., Ampere, N. J.
Dayton Machine & Tool Works, Dayton, O.
Garvin Machine Co. New York.

Grinders, Center—*Continued*

Gem Mfg. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., New York
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett-Dock Co., Boston, Mass.
Stow Mfg. Co., Binghamton, N. Y.
Wells & Sons Co., F. E., Greenfield, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Cylindrical

Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co. Providence, R. I.
Heald Mach. Co., The, Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk

Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov., R. I.
Gardner Machine Co., Beloit, Wis.
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.

Grinders, Drill

Heald Mch. Co., Worcester, Mass
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal

Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mch. Co., Worcester, Mass.
Rivett Dock Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinders, Piston Ring

Heald Machine Co., Worcester, Mass.

Grinders, Portable

Cincinnati Electrical Tool Co., Cincinnati, O.
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Diamond Mach. Co., Prov., R. I.
Dwight Slate Machine Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Head Machine Co, Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Machine Co., Cincinnati, O.
Landis Tool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.

Grinders, Tool—*Continued*

Safety Emery Wheel Co., Springfield, Ohio.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines

Abrasive Material Co., Philadelphia, Pa.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Burke Machinery Co., Cleveland, Ohio.
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Harrington, Son & Co., Edwin, Philadephia, Pa.
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Independent Pneumatic Tool Co., Chicago, Ill.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Montgomery & Co., New York.
National Machine Co., Hartford, Conn.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Star Corundum Wheel Co., Detroit, Mich.
Stow Mfg. Co., Binghamton, N. Y.
Vandyck Churchill Co., New York
Vitrified Wheel Co., Westfield, Mass.
Webster & Perks Tool Co., Springfield, O.
Wells, Sons Co., F. E., Greenfield, Mass.

Grinding Wheels

Adams Co., Dubuque, Iowa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N Y.
Davis Machine Co., W. P., Rochester, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Star Corundum Wheel Co., Detroit, Mich.
Superior Corundum Wheel Co., Waltham, Mass.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames

Athol Machine Co., Athol, Mass.
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery

Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hammers, Drop

Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brookyn, N. Y.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toledo Machine & Tool Co., Toledo, Ohio.
Waterbury Farrel Fdry & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic

Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dayton Pneumatic Tool Co., Dayton, O.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.

Hammers, Power

Bradley & Son, C. C., Syracuse, N. Y.
Fairbanks Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Scranton & Co., The, New Haven, Conn.

Hammers, Steam

Bell Eng. Works, David, Buffalo, N. Y.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Bradley & Son, C. C., Syracuse, N Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Crescent Forgings Co., Oakmont, Pa.
Marshall & Huschart Machinery Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co, New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Handles, Machine Tool

Whitman & Barnes Mfg. Co., Chicago, Ill.

Handles, Screw Plate

Standard Welding Co., Cleve., O.

Hangers, Shafting

Cresson Co., Geo. V., Phila., Pa.
Fairbanks Co., New York.
Hyatt Roller Bearing Co., Harrison, N. J.
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Sturtevant Co., B. F., Hyde Park, Mass.

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Garden City Fan Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Heating Machines

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Chicago Flexible Shaft Co., Chicago, Ill.

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Brown Hoisting Machinery Co., Cleveland, O.
Case Mfg. Co., Columbus, Ohio.
Caldwell & Son Co., H. W., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Jeffrey Mfg. Co., Columbus, O.
Lamson Consolidated S. S. Co., Boston, Mass.

The fact that we make the cutters for many of the largest users—users who are discriminating—who insist on having the best—is proof positive of the quality of our product.
Any cutters shown in our catalog will be furnished in any grade of High Speed Steel ordered.
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Powerful—rigid—accurate—rapid. Works at "tool steel limit" with highest degree of accuracy.

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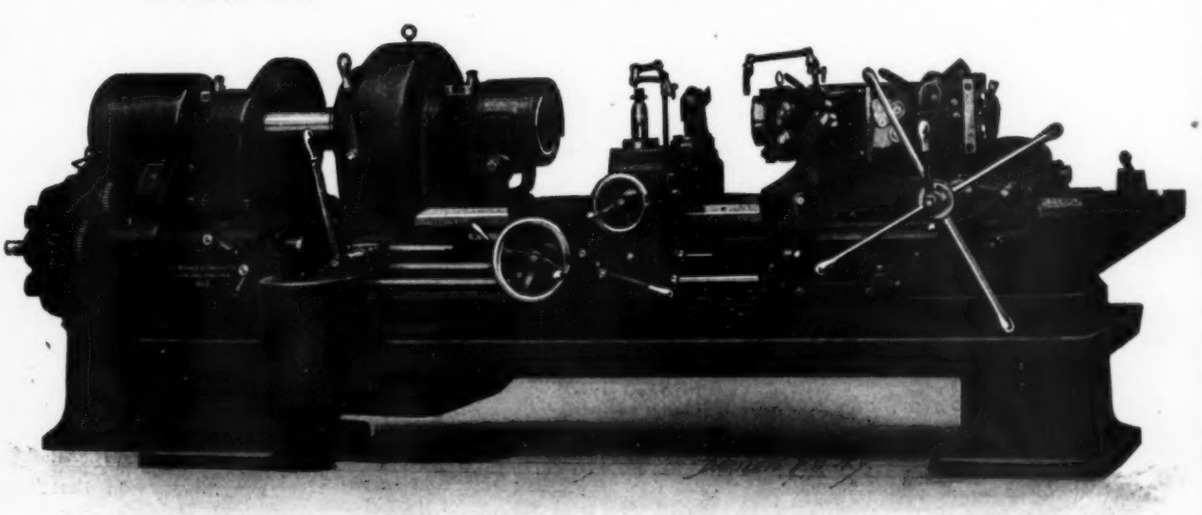

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THE WARNER & SWASEY COMPANY, **CLEVELAND, OHIO, U.S.A.**

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Hoisting and Conveying Machinery —*Continued*

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Main Belting Co., Phila., Pa.
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Niles-Bement-Pond Co., New York.
United Engineering & Fdry. Co., Pittsburg, Pa.

Hoists, Electric

C & C Electric Co., New York.
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Crocker-Wheeler Co., Ampere, N. J.
Curtis & Co. Mfg. Co., St. Louis, Mo.
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General Electric Co., New York.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand

Case Manufacturing Co., Columbus, Ohio.
Chisholm & Moore Mfg. Co., Cleveland, O.
Frevert Machinery Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Moore Co., Franklin, Winsted, Conn.
Nicholls, Wm. S., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic

Chisholm & Moore Mfg. Co., Cleveland, Ohio.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Northern Engineering Works, Detroit, Mich.

Hose, Steel

Sprague Elec. Co., New York.

Igniters, Gas Engine

Franklin Mfg. Co., Syracuse, N. Y.
Goodson Electric Ignition Co., Providence, R. I.

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Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral

Warner Instrument Co., Beloit, Wis.

Indicators, Test

Equipoise Rivet Co., Waterbury, Conn.
Norton Emery Wheel Co., Worcester, Mass.

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Hunt Co., C. W., West New Brighton, N. Y.

Injectors

Desmond-Stephan Mfg. Co., Urbana, O.
International Specialty Co., Detroit, Mich.
Lunkenhemer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

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Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools

See Schools, Correspondence

Instruments, Electric

General Electric Co., New York.
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.

Insurance, Boiler

Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Iron Filler

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Jacks, Hydraulic

Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York

Jacks, Planer

Armstrong Bros. Tool Co., Chicago, Ill.

Kettles, Soda

Brown & Sharpe Mfg. Co., Providence, R. I.
Mfg. Equip. & Engrg. Co., E. Boston, Mass.

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Burr & Sons, John T., Brooklyn, N. Y.
Chattanooga Mchry. Co., Chattanooga. Tenn.
Davis Machine Co., W. P., Rochester, N. Y.
Lapointe Machine Tool Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Gauge Steel Co., Beaver, Falls, Pa.
Whitney Mfg. Co,. Hartford, Ct.

Knives, Shear

Phillips-Laffitte Co., Philadelphia, Pa.

Knurls

Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.

Lamps, Arc

General Electric Co, N. Y. City.
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent

General Elec. Co., New York.
Gilmore Electric Co., South Boston, Mass.
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

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Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bowers, E. J., Philadelphia, Pa.
Bradford Machine Tool Co., Cincinnati, Ohio.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Sloan & Chace Mfg. Co., Newark, N. J.

Lathe Dogs

Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris-Co., Eddystone, Pa.

Lathes

American Tool & Machine Co., Boston, Mas.
American Tool Works Co., Cin., O.
Automatic Mach. Co., Bridgeport, Conn.
Barnes Co., W. F., & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport. Conn.
Burr & Sons, John T., Brookyn, N. Y.

Lathes—*Continued*

Champion Tool Works Co., Cincinnati, O.
Davis Machine Co., W. P., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Diamond Machine Co., Providence, R. I.
Dreses Mach. Tool Co., Cincinnati, O.
Fairbanks Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Conn.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Machry. Co., Chicago, Ill.
Moline Tool Co., Moline, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls. N. Y.
Shepard Lathe Co., Cincinnati, O.
Springfield Mch. Tool Co., Springfield, Ohio.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Walcott & Son, Geo. D., Jackson, Mich.
Wells & Sons Co., F. E., Greenfield, Mass.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co, Windsor, Vt.

Lathes, Automatic Screw-Threading

Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

Lathes, Bench

American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Hardinge Bros., Chicago, Ill.
Mass. Tool Co., Greenfield, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark Tool Co., Waltham, Mass.
Sloan & Chace Mfg. Co., Newark, N. J.
Waltham Machine Works, Springfield, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring

Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Whitman & Barnes Mfg. Co., Chicago, Il.

Lathes, Brass

Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Dreses Mach. Tool Co., Cincin., O.
Pratt & Whitney Co. Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Windsor Mach. Co., Windsor, Vt.

Lathes, Extension

Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
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Lathes, Foot Power

Barnes Co., W. F. & Jno., Rockford, Ill.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Lathes, Speed

Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Blount Co., J. G., Everett, Mass.

Lathes, Wood

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Letters, Pattern

Butler, A. G., New York.

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Mass. Tool Co., Greenfield, Mass.
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Starrett Co., L. S., Athol, Mass.

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Hart & Cooley Co., New Britain, Conn.
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General Electric Co., New York.

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Lunkenheimer Co., Cincinnati, O.

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Fairbanks Co., New York.
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McCabe, J. J., New York.
Motch & Merryweather Co., Cleveland, O.
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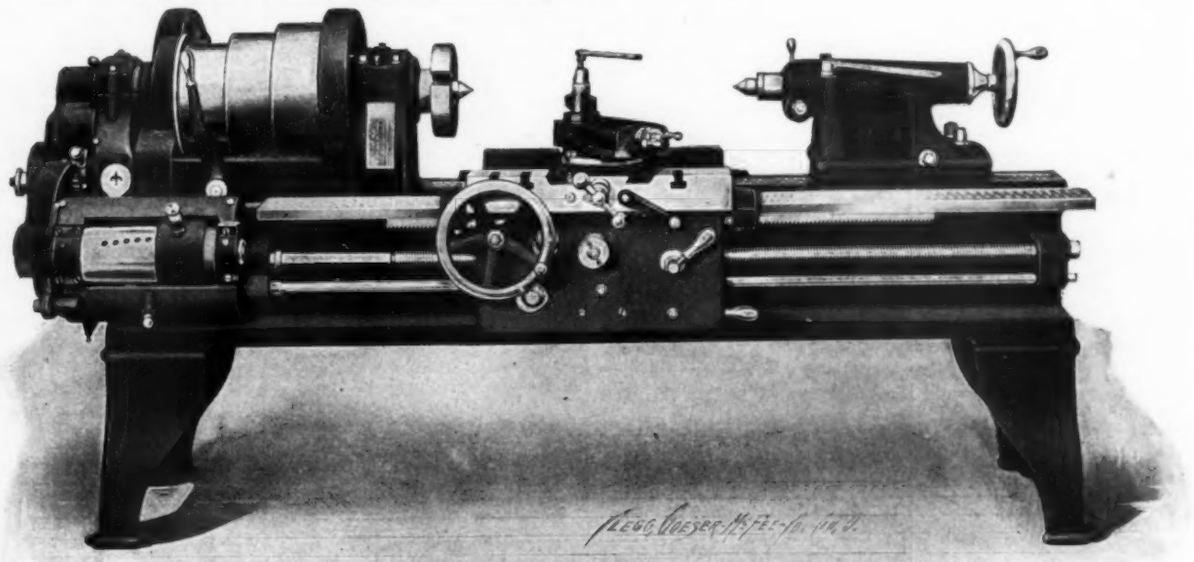

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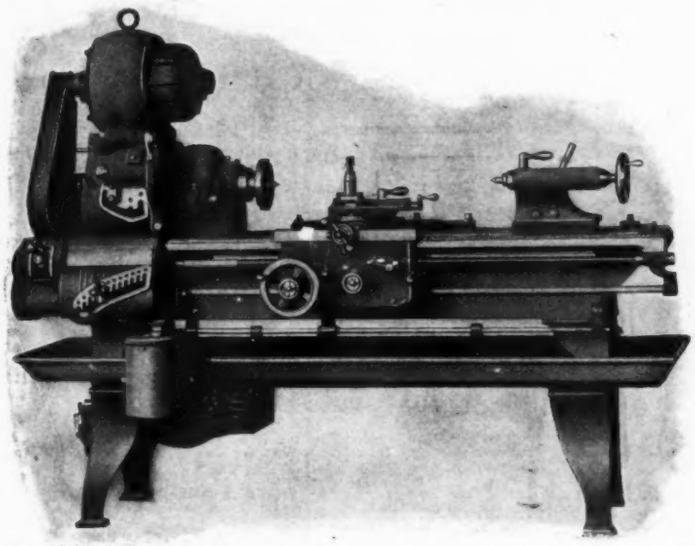

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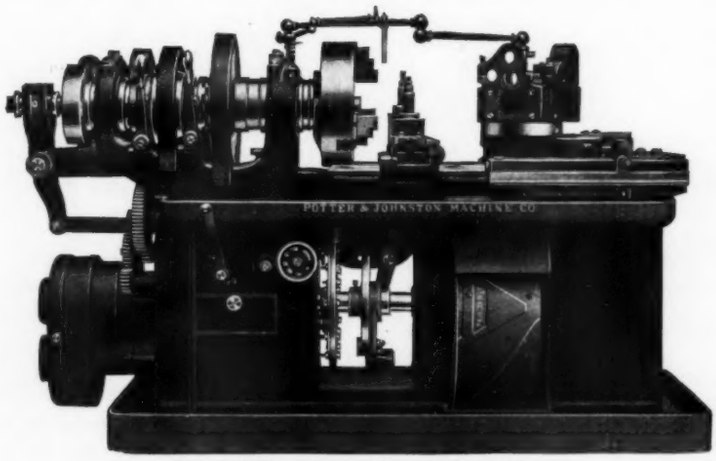

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Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Rockwood Mfg. Co., Indianapolis, Ind.
Taylor-Wilson Mfg. Co., Allegheny, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.
Wilmarth & Morman Co., Grand Rapids, Mich.

Pulley Turning and Boring Machines
American Tool Wks. Co., Cin., O.
Bertram & Sons, Ltd., John, Dundas, Ontario, Canada.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Pumps, Air
Ingersoll-Rand Co., New York.

Pumps, Electric
General Electric Co., New York.

Pumps, Hydraulic
Elmes Eng. Works, Chas. F., Chicago, Ill.
General Electric Co., New York.
Watson-Stillman Co., New York.

Pumps, Steam
Ingersoll-Rand Co., New York.
International Steam Pump Co,, New York.
Montgomery & Co., New York.

Punches, Centering
Brown & Sharpe Mfg. Co., Providence, R. I.
Goodell Mfg. Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Mass. Tool Co., Greenfield, Mass.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Punches, Hand
Bertsch & Co., Cambridge City, Ind.
Marchant, Geo. F., Chicago, Ill.
Niagara Machine & Tool Works, Buffalo, N. Y.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Punches, Hydraulic
Bethlehme Fdry. & Mch. Co., So. Bethlehem, Pa
Niles-Bement-Pond Co., New York.
United Engineering & Fdry. Co., Pittsburg, Pa.
Prentiss Tool & Supply Co., New York.
Watson-Stillman Co., New York.

Punches, Power
Bertram & Sons Co, Ltd., John, Dundas, Ont., Canada.
Bertsch & Co., Cambridge City, Ind.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Long & Allstatter Co., Hamilton, Ohio.
Niagara Machine & Tool Works, Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.

Rack Cutting Machines
Adams Co., Dubuque, Iowa.
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Walcott & Son, Geo. D., Jackson, Mich.

Racks, Cut
Boston Gear Wks., Boston, Mass.
Cleveland Wire Spring Co., Cleveland, Ohio.
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
LeBlond Mach. Tool Co., R. K., Cincinnati, Ohio.
Nuttall Co., R. D., Pittsburg, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Walcott & Son, Geo. D, Jackson, Mich.

Racks, Tool
Lyon Metallic Mfg. Co., Chicago, Ill.
Mfg. Equip. & Engrg. Co., E. Boston, Mass.
New Britain Mch. Co., New Britain, Conn.

Radiators, Japanning Oven
American Gas Furnace Co., New York.
Hardinge Bros., Chicago, Ill.
Mass. Tool Co., Greenfield, Mass.

Radiators, Japanning Oven *Continued.*
Rivett Mfg. Co., Boston, Mass.
Stark Tool Co., Waltham, Mass.

Reamers
Boker & Co., Hermann, New York.
Carpenter Tap & Die Co, J. M., Pawtucket, R. I.
Chadwick & Co., G. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
Gisholt Mach. Co., Madison, Wis.
Hammacher, Schlemmer & Co., New York.
Independent Pneumatic Tool Co., Chicago, Ill.
International High Speed Steel Co, New York.
Lapointe Mach. Tool Co., Boston, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Schellenbach & Darling Tool Co. Cincinnati, O.
Standard Tool Co., Cleveland, O.
Three Rivers Tool Co., Three Rivers, Mich.
Wells Bros Co., Greenfield, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Reheaters, Steam
Ingersoll-Rand Co., New York.

Recorders, Speed
Niagara Tachometer & Inst. Co., Niagara Falls, N. Y.

Rheostats
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Rims and Bands
Standard Welding Co., Cleve., O.

Rings, Chuck and Gear
Standard Welding Co., Cleve., O.

Riveters, Hydraulic
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Chisholm & Moore Mfg. Co., Cleveland, O.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Riveters, Steam
Chambersburg Engineering Co., Chambersburg, Pa.

Riveting Machines
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.
National Machinery Co., Tiffin, O.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Roller and Ball Bearings
Auburn Ball Bearing Co., Rochester, N. Y.
Boston Gear Wks., Boston, Mass.
Hess-Bright Mfg. Co., Phila., Pa.
Hyatt Roller Bearing Co., Harrison, N. J.

Roller Mills, Coining
Dill Mach. Works, T. C., Philadelphia, Pa.

Rolling Mill Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Dill Mach. Works, T. C., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburg, Pa.
Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Rolls, Forging
Niagara Machine & Tool Works, Buffalo, N. Y.

Rules, Steel
Athol Machine Co., Athol, Mass.
Billings & Spencer Co., Hartford, Conn.
Hammacher, Schlemmer & Co., New York.
Lufkin Rule Co., Saginaw, Mich.
Mass. Tool Co., Greenfield, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Sand Blast Apparatus
Drucklieb, C., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadelphia, Pa.
Tilghman Brooksbank Sand Blast Co., Philadelphia, Pa.

Saw Frames and Blades
Diamond Saw & Stamping Works, Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Massachusetts Saw Works, Chicopee, Mass.
Millers Falls Co., New York.
Montgomery & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Saw Sharpening Machines
Cochrane-Bly Co., Rochester, N. Y.
Nutter, Barnes & Co., Boston, Mass.

Sawing Machines, Metal
Birdsboro Steel Fdry, & Mach. Co., Birdsboro, Pa.
Burr & Sons, Jno. T., Brooklyn, N. Y.
Cochrane-Bly Co., Rochester, N. Y.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Nutter, Barnes & Co., Boston, Mass.
Tabor Mfg. Co., Phila., Pa.
Tindel-Morris Co., Eddystone, Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood
Colburn Mach. Tool Co., Franklin. Pa.
Marston & Co., J. M., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Saws, Hack Power
Diamond Saw & Stamping Works, Buffalo, N. Y.
Fairbanks Co., N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
Montgomery & Co., New York.
Niles-Bement-Pond Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Saws, Metal Band
Greaves, Klusman & Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Schools, Correspondence
American School of Correspondence, Chicago, Ill.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
Michigan College of Mines, Houghton, Mich.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Davis Machine Co., W. P. Rochester, N. Y.
Dreses Mach. Tool Co., Cincin., O.
Marshall & Huschart Mach. Co., Chicago, Ill.
National-Acme Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Wells & Sons Co., F. E., Greenfield, Mass.
Windsor Mach. Co., Windsor, Vt.

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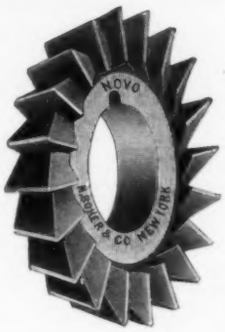

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Screw Machines, Hand

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Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe Mfg. Co., Boston, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Machine Co., Windsor, Vt.

Screw Machinery, Wood and Lag

Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Ct.
Hammacher, Schlemmer & Co., New York.

Screw Plates

Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Hart Mfg. Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Reece Co., E. F., Greenfield, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Screws, Cap and Set

Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Screws, Machine

Cleveland Cap Screw Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
National-Acme Mfg. Co., Cleveland, O.
Standard Gauge Steel Co., Beaver Falls, Pa.
Worcester Mach. Screw Co., Worcester, Mass.

Second Hand Machinery

American Tool Wks. Co., Cin., O.
Baird Machy. Co., Pittsburg, Pa.
Chandler & Farquhar, Boston, Mass.
Fairbanks Co., New York.
Frevert Machry Co., New York.
Garvin Mach. Co., New York.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Mchry. Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Pattison Mach. Co., W. M., Cleveland, O.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machry. Co., C. C., Detroit, Mich.

Separators, Magnetic

Cresson Co., Geo. V., Phila., Pa.
General Electric Co., New York.

Separators, Oil and Steam

American Tool & Machine Co., Boston, Mass.
Curtis, A. B., Worcester, Mass.
National Separator & Machine Co., Concord, N. H.
Nicholson & Co., W. H., Wilkesbarre, Pa.

Shades and Sockets, Lamp

D'Olier & Co., H., Phila., Pa.

Shaft Couplings

Davis Machine Co., W. P., Rochester, N. Y.

Shafting

Cresson Co. Geo. V., Phila., Pa.
Cumberland Steel Co., Cumberland, Md.
Niles-Bement-Pond Co., New York
Pressed Steel Mfg. Co., Philadelphia, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

Shapers

American Tool Wks. Co., Cin., O.
Barker & Co., Wm., Cincinnati, Ohio.
Bertram & Sons Co., Ltd., John, Dundas, Ont. Canada.
Blount Co., J. G., Everett, Mass
Boynton & Plummer, Worcester, Mass.
Cincinnati Shaper Co., Cincin., O.
Cochrane-Bly Co., Rochester, N. Y.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Mach. Co., Torrington, Ct.
Kelly Mach. Co, R. A., Xenia, O.
Marshall & Huschart Mach. Co., Chicago, Ill.
Morton Manufg. Co., Muskegon Heights, Mich.
Niles-Bement-Pond Co., New York.
Potter & Johnston Machine Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rockford Machine Tool Co., Rockford, Ill.
Shepard Lathe Co., Cincinnati, O.
Smith & Mills, Cincinnati, Ohio.
Springfield Mch. Tool Co., Springfield, Ohio.
Steptoe Shaper Co., John, Cin., O.
Vandyck Churchill Co., New York.
Walcott & Son, Geo. D., Jackson, Mich.

Shears, Power

Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bertsch & Co., Cambridge City, Ind.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Long & Allstatter Co., Wilmington, Del.
Niagara Machine & Tool Works, Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Swaine Co., Fred. J., St. Louis, Mo.
Toledo Machine & Tool Co., Toledo, Ohio.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Shears, Rotary

Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Niagara Machine & Tool Works, Buffalo, N. Y.
United Engineering & Fdry Co., Pittsburg, Pa.

Sheet Metal Working Machinery

Bliss Co., E. W., Brooklyn, N. Y.
Niagara Machine & Tool Works, Buffalo, N. Y.

Shelving, Shop

New Britain Mch. Co., New Britain, Conn.

Slide Rests

American Watch Tool Co., Waltham, Mass.
Bartlett, E. E., Boston, Mass.
Betts Mach. Co., Wilmington, Del.
Blount Co., J. G., Everett, Mass.
Garvin Machine Co., New York.
National-Acme Mfg. Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Wells & Sons Co., F. E., Greenfield, Mass.

Slotters

Baker Bros. Toledo, O.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Betts Machine Co., Wilmington, Del.
Dill Mach. Works, T. C., Philadelphia, Pa.
Garvin Mach. Co., New York.
National-Acme Mfg. Co., Cleve., O.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Works, Philadelphia, Pa.

Slotters—*Continued*

Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Soap, Machinists'

Boyer Bros., New York.

Sockets and Sleeves

Cleveland Twist Drill Co., Cleveland, O.
Standard Tool Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Soldering Fluid

Elliott Chemical Works, Newton, Mass.

Special Machines and Tools

Atlas Machine Co., Providence, R. I.
Automatic Mach. Co., Bridgeport, Conn.
Beaman & Smith Co., Prov., R. I.
Bilgram, Hugo, Philadelphia, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Bliss Co., E. W., Brooklyn, N. Y.
Burke Machinery Co., Cleveland, Ohio.
Burr & Sons, Jno. T., Brooklyn, N. Y.
Cleveland Cap Screw Co., Cleveland, O.
Crescent Forgings Co., Oakmont, Pa.
Dexter, Chas. S., Attleboro. Mass.
Elmes Eng. Works, Chas. F., Chicago, Ill.
Fawcus Mach. Co., Pittsburg, Pa.
Fenn-Sadler Machine Co., Hartford, Conn.
Gardner Engineering Co., New York.
Globe Machine & Stamping Co., Cleveland, O.
Hoefer Mfg. Co., Freeport, Ill.
Lucas Mach. Tool Co., Cleveland, Ohio.
Mechanics Machine Co., Rockford, Ill.
Mueller Mach. Tool Co., Cin., O.
National-Acme Mfg. Co., Cleveland, O .
Natl. Machinery Co., Tiffin, Ohio.
Nazel Engineering & Machine Works, Philadelphia, Pa.
New Machine Co., Danbury, Conn.
Nutter, Barnes & Co., Boston, Mass.
Poole Co., J. Morton, Wilmington, Del.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburg, Pa.
Standard Engineering Works, Ellwood City, Ind.
Swaine Co., Fred. J., St. Louis, Mo.
Three Rivers Tool Co., Three Rivers, Mich.
Walcott & Son, Geo. D., Jackson. Mich.

Spike Machinery

National Machry. Co., Tiffin, O.

Spools, Steel

Standard Welding Co., Cleve., O.

Springs, Wire

Cleveland Wire Spring Co., Cleveland, Ohio.

Sprockets

Baldwin Chain & Mfg. Co., Worcester Mass.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cullman Wheel Co., Chicago, Ill.
Link-Belt Engineering Co., Philadelphia, Pa
Whitney Mfg. Co., Hartford, Ct.

Stampings, Sheet Metal

American Tube & Stamping Co., Bridgeport, Conn
Globe Machine & Stamping Co., Cleveland, O.
Holbrook Mfg. Co., Attleboro. Mass.
Niagara Machine & Tool Works, Buffalo, N. Y.

Stampings, Welded

American Tube & Stamping Co., Bridgeport, Conn.
Standard Welding Co., Cleveland Ohio.

Stamps, Steel

Schwerdtle Stamp Co., Bridgeport, Conn.

Steam Specialties

Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.

Steel, Air Hardening

Baldwin Steel Co., New York.
Boker & Co., Hermann, New York
Firth-Stirling Steel Co., Demmer, Pa.
International High-Speed Steel Co., New York.
Jones & Co., B. M., Boston, Mass.
Kent & Co., Edwin R., Chicago, Ill.

Steel, Machinery

Boker & Co., Hermann, New York.
Firth-Stirling Steel Co., Demmler, Pa.
Frasse Co., Peter A., New York.
Heller Bros. Co., Newark, N. J.
International High-Speed Steel Co., New York.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet

American Tube & Stamping Co., Bridgeport, Conn.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool

American Tube & Stamping Co., Bridgeport, Conn.
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Stirling Steel Co., Demmler, Pa.
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Heller Bros. Co., Newark, N. J.
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Patterson, Gottfried & Hunter, Ltd., New York.
Phillips-Lafitte Co., Phila., Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Stocks, Die

See Taps and Dies.

Straightening Machinery

Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Fitchburg Machine Works, Fitchburg, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Springfield Mch. Tool Co., Springfield, O.
United Engineering & Fdry. Co., Pittsburg, Pa.

Straighteners, Hydraulic

Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Straighteners, Screw

Towsley Mfg. Co., Jno. T., Cincinnati, Ohio.

Swaging Machines

Excelsior Needle Co., Torrington, Conn.

Switchboards

C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., Schenectady, N. Y.
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Switches

General Electric Co., New York.
Stanley-G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg Co., Pittsburg, Pa.

Tachographs

Niagara Tachometer & Inst. Co., Niagara Falls, N Y.

Tachometers

Niagara Tachometer & Inst. Co., Niagara Falls, N Y.

Taper Pins

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.

Tapes, Measuring

Lufkin Rule Co., Saginaw, Mich.
Starrett Co., L. S., Athol, Mass.

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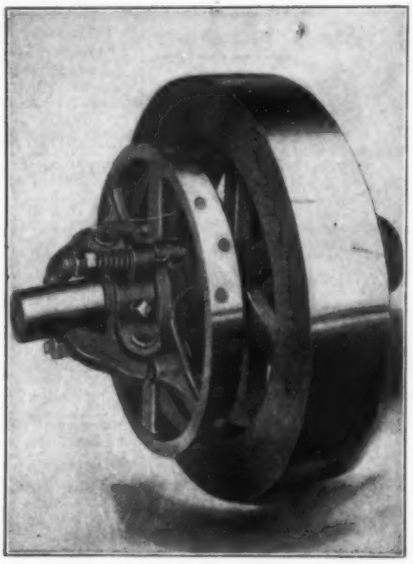

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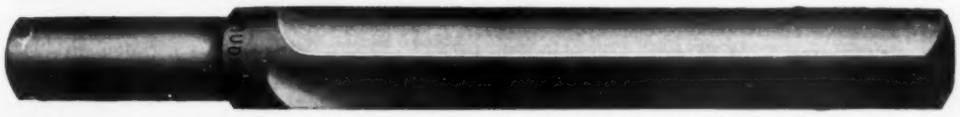

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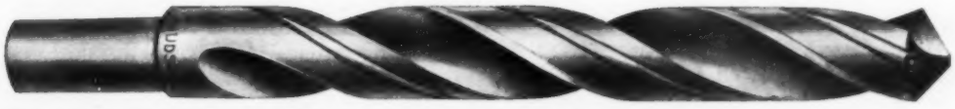

Baldwin Steel Co., Makers, 133 Reade St., NEW YORK

BIRMINGHAM. BOSTON. PHILADELPHIA. PITTSBURG.

Tapping Machines and Attachments
American Tool Wks. Co., Cin., O.
American Watch Tool Co., Waltham, Mass.
Baker Bros., Toledo, Ohio.
Beaman & Smith Co., The, Providence, R. I.
Bickford Drill & Tool Co., Cincinnati, O.
Burke Machinery Co., Cleveland, Ohio.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., New York.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Tool Co., New Haven, Conn.
Gould & Eberhardt, Newark, N. J.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Marshall & Huschart Mach. Co., Chicago, Ill.
Montgomery & Co., New York.
Natl. Machinery Co., Tiffin, Ohio.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sloan & Chace Mfg. Co., Newark, N. J.
Webster & Perks Tool Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Taps and Dies
Bay State Tap & Die Co., Mansfield, Mass.
Besly & Co, Chas. H., Chicago, Ill.
Brubaker & Bros., W. L., Millersburg, Pa.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Geometric Tool Co., New Haven, Conn.
Frasse Co., Peter A., New York.
Hammacher, Schlemmer & Co., New York.
Hardinge Bros., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co. New Bedford, Mass.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reece Co., E. F., Greenfield, Mass.
Reed Mfg. Co., Erie, Pa.
Standard Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Taps, Collapsing
Kelly, P. J., Elizabeth, N. J.
Geometric Tool Co., New Haven, Conn.

Tap Remover, Broken
Atlas Machine Co., Providence, R. I.

Testing Machines
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Thermit
Goldschmidt Thermit Co., New York.

Thermometers
Bristol Co., Waterbury, Conn.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Hart Mfg. Co., Cleveland, O.
Kelly, P. J., Elizabeth, N. J.
Natl. Machinery Co., Tiffin, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Rogers Works, Jno. M., Gloucester City, N. J.
United Engineering & Fdry. Co., Pittsburg, Pa.
Western Tool & Mfg. Co., Springfield, O.

Time Recorders
Calculagraph Co., New York.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
O. K. Tool Holder Co., Shelton, Conn.

Tool Holders—*Continued*
Pratt & Whitney Co., Hartford, Conn.
Schacht Mfg. Co., Cincinnati, O.
Western Tool & Mfg. Co., Springfield, O.

Tools, Small
See Machinists' Small Tools.

Torches for Light and Heat
Gem Mfg. Co., Pittsburg, Pa.

Transformers and Converters
General Elec. Co., New York.
Stanley-G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Transmission Machinery
American Pulley Co., Phila, Pa.
Bowers, E. J., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Rockwood Mfg Co., Indianapolis, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.
Wood's Sons Co., T. B., Chambersburg, Pa.

Traps, Steam
American Blower Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Trolleys and Tramways
Brown Hoisting Mchry. Co., Cleveland, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Yale & Towne Mfg. Co., New York.

Trolley Wheels
Lumen Bearing Co., Buffalo, N. Y.

Trucks, Shop
Towsley Mfg. Co., J. T., Cincinnati, Ohio.

Tubing, Steel
Almond Mfg. Co., T. R., Brooklyn, N. Y.
American Tube & Stamping Co., Bridgeport, Conn.
Standard Welding Co., Cleveland, O.
Ward & Sons, Edgar T., Boston, Mass.

Turntables
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Turret Heads
Almond Mfg. Co. T. R., Brooklyn, N. Y.
Baker Machine Co., New Bedford, Mass.
Elmira Machine Works, Elmira, New York.

Turrets, Carriage
Blount & Co., J. G., Everett, Mass.

Turret Machines
American Tool & Machine Co., Boston, Mass.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Gisholt Mach. Co, Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Machry. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros., Worcester, Mass.

Turret Machines—*Continued*
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland, Ohio.
Wells & Sons Co., F. E., Greenfield, Mass.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Boker & Co., Hermann, New York.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
International High Speed Steel Co., New York.
Jones & Co., B. M., Boston, Mass.
Montgomery & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Omega Steel & Tool Co., Ansonia, Conn.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Tool Co., Cleveland, O.
Ward & Sons, Edgar T., Boston, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Unions, Brass
Lunkenheimer Co., Cincinnati, O.

Universal Joints
Baush Mach. Tool Co., Springfield, Mass.
Boston Gear Wks., Boston, Mass.
Gould & Eberhardt, Newark, N. J.
Gray & Prior Mach. Co., Hartford, Conn.
Mutual Machine Co., Hartford, Conn.
Spicer Reversible Joint Mfg. Co., Plainfield, N. J.

Valves
See Steam Specialties.

Valves, Cylinder Relief
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.

Valves, Safety Pop
Lunkenheimer Co., Cincinnati, O.

Vises, Drill
Graham Mfg. Co., Prov., R. I.
Hopkinson Machine Wks., Springfield, Mass.

Vises, Metal Workers'
Athol Machine Co., Athol, Mass.
Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Merrill Bros., Brooklyn, N. Y.
Millers Falls Co., New York.
Prentiss Vise Co., New York.
Parker Co., Chas., Meriden, Conn.
Reed Mfg. Co., Erie, Pa.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Emmert Mfg. Co., Waynesboro, Pa.
Prentiss Vise Co., New York.
Saunders Sons, D., Yonkers, N. Y.
Reed Mfg. Co., Erie, Pa.

Vises, Planer and Shaper
American Tool Wks. Co., Cin., O.
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Conn.
Niles-Bement-Pond Co., New York.

Vises, Universal Machine
Graham Mfg. Co., Prov., R. I.
Hopkinson Machine Wks., Springfield, Mass.

Vise Stands, Portable
Le Blond Mach. Tool Co., R. K., Cincinnati, Ohio.

Vises, Wood Workers'
Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Parker Co., Chas., Meriden, Conn.
Wyman & Gordon, Worcester, Mass.

Washer Machinery
Natl. Machinery Co., Tiffin, Ohio.

Wash Stands
Mfg. Equip. & Engrg. Co, E. Boston, Mass.

Welding
Goldschmidt Thermit Co., New York.

Welding, Electric
American Tube & Stamping Co., Bridgeport, Conn.
C & C Electric Co., New York.
Standard Welding Co., Cleveland, Ohio.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Welding Plates
Phillips-Laffitte Co., Phila., Pa.

Wheels, Disc
American Blower Co., Detroit, Mich.

Wire and Cables
General Electric Co., New York.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wire Nail Machinery
Natl. Machinery Co., Tiffin, Ohio.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.
Prentiss Tool & Supply Co., New York.

Wood Working Machinery
Prentiss Tool & Supply Co., New York.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Worm Hobbing Machines
Gould & Eberhardt, Newark, N. J.
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Monarch Tool Works, St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.
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Wrenches, Machinists'
Athol Machine Co., Athol, Mass.
Bay State Tool Co., Worcester, Mass.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Billings & Spencer Co., Hartford, Conn.
Bullard Auto. Wrench Co., Providence, R. I.
Coes Wrench Co., Worcester, Mass.
Hammacher, Schlemmer & Co., New York.
Monarch Tool Works, St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

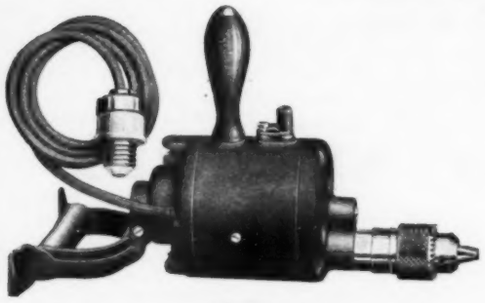
Wrenches, Pipe
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bullard Automatic Wrench Co., Providence, R. I.
Monarch Tool Works, St. Louis, Mo.
Reed Mfg. Co., Erie, Pa.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Wrenches, Ratchet
Bay State Tool Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Whitman & Barnes Mfg. Co., Chicago.

Wrenches, Tap
Card Mfg. Co, S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

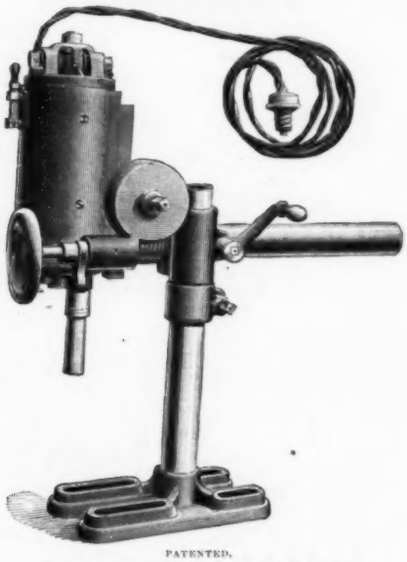
Wrenches, Universal
Bullard Auto. Wrench Co., Providence, R. I.
Monarch Tool Works, St. Louis, Mo.
Phillips-Laffitte Co., Phila., Pa.
Whitman & Barnes Mfg. Co., Chicago, Ill.

If it's a "Hisey-Wolf", it's right.



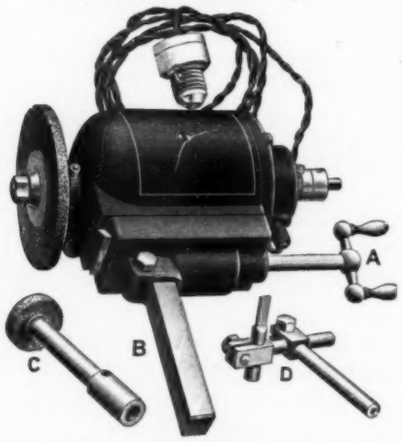
PATENTED.

Portable Electrical Hand or Breast Drill
4 sizes, **1-4** in., **3-8** in., **1-2** in., **3-4** in. capacities.
Weights, **8** to **19** lbs., respectively.
Chuck arranged for close corner drilling.
Speed can be changed while running.
Extra side handle if required.



PATENTED.

Portable Electrical Scotch Radial Drill.
Made in **2** sizes of **7-8** in. and **1 1-4** in. in steel.
12 in. Hand-feed, with quick return by hand.
Can be taken anywhere, as any length cord can be used.
No belt connections of any kind. Does away with carrying heavy work to the drill press.



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Portable Tool Post Electrical Grinder.
For grinding Centers, Cutters, Reamers, Dies, Rolls and Internal and Surface Grinding
Set in Tool-post of Lathe, Planer or Milling Machine.
3 sizes of **1-4, 1-2, 1** Horsepower.
Weights: **16, 35, 68** lbs. respectively.
Bench Grinders, Hand Grinders and Buffers.

THE MOST ESSENTIAL

feature, besides durability, in a Portable Electrical Drill is weight. You can do twice as much work in one-half the time with our Tools, because of their lightness. Built for wear and tear. Take the Drill to the work and not heavy work to the drill-press. Saves time, trouble and expense.

QUALITY FIRST AND LAST.

Our Tools may perhaps be a little higher in price than other makes, but there's a reason. We give better material, better workmanship, better design and the durability of our Tools makes them considerable lower in price in the end. Our maxim is not how cheap, but how good.

A FAIR PROPOSITION.

We do not ask you to take our word for the superior merits of our Tools, but if you will permit us, we will send any of them subject to trial. If not satisfactory in every respect you can return them to us without expense or obligation of any kind to yourself. We guarantee them in every way.

Motor with Flexible Shaft.
Internal Grinders.

POWER FROM ANY LAMP SOCKET,
DIRECT or ALTERNATING CURRENT.

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MONARCH WRENCH COMPANY

(Successors to MONARCH TOOL WORKS)

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MANUFACTURERS OF WRENCHES

The Monarch is the only adjustable alligator manufactured.

Made in one size only, with 18" handle taking from ¼ to 2½ inches. It is the handiest wrench around any shop or place where wrenches are used. Can be used on work where other wrenches cannot be operated, and will perform the work of any class of wrenches.

WILL READILY SAVE ITS COST IN TIME OF MECHANICS NOW USED IN GETTING PROPER WRENCHES TO DO WORK AT HAND.

The Wisest Man Can't Answer Every Question,

and neither can the best book. But the book shown here:

"Questions and Answers From The American Machinist,"

answers 1088 of those questions which are most intimately connected with the work of machinists and shopmen; and they are so arranged that they are instantly available for shop use.

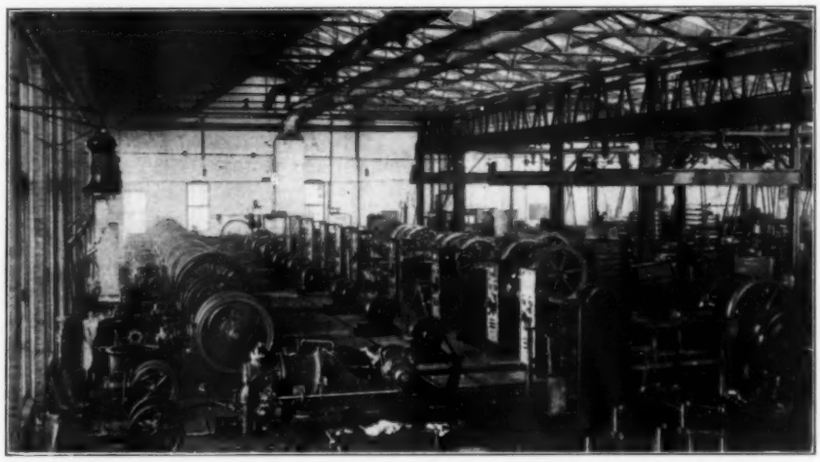
It's a decidedly interesting book of 403 pages, 8x5½ inches in size, and strongly bound in green linen cloth.

The price is $1.50, but of course it is worth ever so much more to anybody who does mechanical work.

Hill Publishing Company, 505 Pearl Street **New York**

The Electrical Equipment of the Olds Gas Power Company, Lansing, Michigan.

When one thinks of the test department of a large gas-engine manufactory, the picture is conjured up of a row of engines with their fly-wheels embraced by Prony brakes, all noisily barking away and eating up gas or gasolene in the production of a large amount of energy, merely to be dissipated in the air and the streams of warm water flowing away from the brakes. And yet these same works are great consumers of power, and have other engines installed for the purpose of furnishing it. If one reflects, it does seem an unreasonable waste, and for this reason the following description of a place where they utilize the power developed in the testing department and waste as little as possible will be of interest.



INTERIOR OF OLDS GAS POWER COMPANY'S FACTORY.

The building occupied by the Olds Gas Power Company, of Lansing, Mich., is laid out in the form of the letter L, with the top projecting toward the west. The castings for the engines are made in the foundry of the Olds Motor Works, and are delivered into the west end of the engine factory, worked through the cleaning department and machine shop, and assembled near the east end. After assembling, the engines are placed upon a foundation with slotted rails, called the working-down stand, on which the bearings, cylinders and other wearing parts are worn down to good bearing surfaces, the power being derived from a line shaft driven by other power. When in condition for operation they are taken to the testing stand, which is similar to the working-down stand just described, and is located at the east end of the main building and provided with slotted rails, and, after that, to the paint room at the north end of the wing, where they are painted and loaded for shipment.

The castings and other engine parts are handled by means of three 5-ton, three-motor, electric traveling cranes from the point of entrance at the west end of the main part of the building to the north end of the wing, and the progress of the work is entirely in one direction from the time the parts enter until the completed engine leaves the factory.

THE GENERATORS.

A novel feature of this plant is that nearly all the power used is generated by engines under test. On a long foundation adjacent to the testing stand there are located eight generators with an aggregate capacity of 168 kw., and ranging from 35 kw. to 10 kw. Each generator has its individual switchboard. These generators are compound wound for 250 volts, direct current, constant potential, and, with the exception of one Westinghouse type M, all are Westinghouse type S. Generators of different capacities were installed to provide one of suitable size to load each engine manufactured by the company, the engines ranging from 18 to 50 h.p. Beneath the floor on which the switchboards are located is a passage about 6 ft. 6 in. deep, in which are run the bus bars and connecting conductors. From the south end of the main bus bars, four 500,000-c. m. lead-covered cables connect to the distributing switchboard in the southwest corner of the testing department, from which the several sets of distributing mains run to the various parts of the factory and to the office building.

THE LIGHTING EQUIPMENT.

The general lighting is obtained from one hundred and twenty-two constant-potential, direct-current, 120-volt arc lamps, each controlled by a snap switch on an adjacent column, and four hundred and seventy-six, 120-volt, 16-c.p. incandescent lamps are installed for special lighting at tools, benches, etc. Three-wire mains are employed in this service with a 4-kw. motor generator balancer connected to the three-wire bus bars for the purpose of equalizing the voltage should the load between the neutral wire and either of the outside conductors become unbalanced. As a safeguard against unbalanced loads, the lamps are connected alternately between the neutral and the positive and negative leads. In order that the load betwen the two sides of the lighting system may be balanced, the sixteen arc lamps in the immediate vicinity of the distributing switchboard are connected on four sets of mains each provided with a double-throw switch on the distributing switchboard, so that all these lamps or any number of the four circuits may be connected to either side of the system at the will of the operator. A double-reading ammeter is located immediately above these switches, and a pilot lamp is mounted on each side of the ammeter, one lamp being connected between the positive conductor and the neutral, and the other between the negative conductor and the neutral. The reading of the ammeter and the relative brilliancy of the pilot lamps indicate the amount of unbalancing of the load.

Included in the general lighting is a watch-light service consisting of a number of 16-c.p. incandescent lamps distributed at wide intervals in the factory for general dim lighting, and for watchman's service. These lights are also connected to a double-pole, double-throw switch at the switchboard, and may be thrown on either side of the system for the purpose of balancing the load.

THE POWER CIRCUITS.

All power circuits are 240-volt two-wire, and are connected to two-wire mains controlled by double-pole switches, at the distributing switchboard. The heating-fan motors are all connected to one set of mains controlled by a switch and a set of mains is run to each of the three traveling cranes with a switch, all switches being mounted on this distributing switchboard. A circuit breaker is connected in the bus-bar circuit leading to the traveling cranes so that, in the event of a short circuit on any of the cranes or upon the trolley wiring, this circuit breaker will open while those on the generator switchboards will remain closed, and the other operations of the plant will not be interrupted.

The wiring for lights and motors is in general run with cleats on wood posts bolted to the steel work and in "loricated" iron conduit down columns.

THE TESTING PLANT.

The method used in testing engines in this factory is a unique departure from the old established practice, and is considered more accurate than a Prony brake by the engineers and architects, Field, Hinchman & Smith, of Detroit, who designed the building and its electrical equipment. After each engine is taken from

the working-down stand it is placed on the testing stand and run for a short time with its own power. It is then belted to a generator of suitable capacity and run on a water rheostat until it is capable of carrying sufficient load to warrant connecting its generator in parallel with the other machines, at which time it is connected in parallel with the others by throwing over a three-pole, double-throw switch on its switchboard. A pilot light is provided upon each generator switchboard, which is lighted whenever a generator is carrying a water rheostat load, thus preventing the accidental connection of two generators in parallel on the rheostat without notice.

After the engine has run for a sufficient length of time to enable it to develop 10 per cent. more than its rated brake horsepower the generator is again connected to the water rheostat and the engine is given its test run. The power developed by the engines is at all times shown by indicating wattmeters, one of which is mounted on each switchboard. These instruments are of the horizontal edgewise type with two scales, one above the needle and one below. One scale is graduated to read directly the kilowatt output of the generator with which it is connected, and the other scale to read the corresponding horse-power delivered to the generator pulley. To obtain the various points of this second scale, the various kilowatts output were reduced to corresponding horse-power and then multiplied by the efficiency of the generator with which the instrument was to be used. The generators were all tested at the factory by the Westinghouse company and copies of the efficiency curves were furnished to the instrument makers for use in calibration. By the use of one of these instruments the brake horse-power delivered to a generator which is being driven by an engine under test is accurately indicated at all times. If there should be belt slippage, this power, of course, would be less than that generated by the engine; but, as all the generators have belt-tightening bases, this slippage can be made so small as to be practically negligible. At all events the reading will not favor the engine and the power delivered at the engine pulley will be equal to or greater than the reading of the instrument.

Again, should a generator be operating at a lower efficiency at the time of the test of an engine than at the time of the factory test of the generator, the reading of the wattmeter will be less than the horse-power delivered to the generator. Consequently, the maker of the engine is always abundantly safe in guaranteeing the output as obtained by the readings of one of these wattmeters.

In addition to the three-pole double-throw generator switch, the water rheostat pilot lamp and the indicating wattmeter already mentioned, each generator switchboard is equipped with a circuit breaker, an ammeter, a voltmeter, the field rheostat for the generator, a ground detector and two lamps, one connected to the main bus-bars and located over the voltmeter, and one connected to the generator leads and located over the ammeter.

The equalizers for the generators are all connected through the middle blades of the three-pole switches to a short equalizer bus bar near the 35-kw. machines, the endeavor being made to keep the connection to the generators of such size and length that the drop in potential over them will be the same in each case if the equalizer connections carry the full load of the generator.

A room has been provided in the basement under the testing department for the future installation of a storage battery so that, if there should come a time when the ordinary shop load would not be sufficient to provide loads for testing, the storage battery can be charged and then discharged on night loads for lighting and the operation of heating fans and for extra heavy day loads. As a further provision for additional load, a second water rheostat has been provided with a connection from the bus bars on the distributing switchboard. This water rheostat is controlled by a switch on the distributing switchboard and a single-pole circuit breaker is connected in one side of the circuit. Up to the present time, however, the shop load has been more than sufficient to provide loads for testing purposes, and there has been no need for the use of a storage battery or the second water rheostat.

It might be interesting also to note the method of operation of the water rheostats. Each rheostat consists of an open steel tank, which forms the negative electrode, and a steel plate suspended inside and insulated from the tank, which forms the positive electrode. The tank is also insulated from the ground. The electrical connections to the two electrodes are made by means of lead-covered cables.

The saline solution, which may be made of any desirable strength by the use of variable quantities of salt and water, is forced by means of compressed air into the tank from a closed supply tank in the basement. The connection from this tank to the rheostat is of lead pipe incased in extra heavy rubber hose and the supply tank is mounted on insulating supports. An air line containing compressed air is run along the basement ceiling under the switchboards and a connection is made to two three-way cocks at each switchboard, from each of which an air pipe runs to the top of each supply tank. A scale has been provided on the inside of the wall of the building opposite each rheostat and a pointer operated by a float in the rheostat tank indicates the level of the water in the tank. The operator can then stand at the switchboard and, by throwing a three-way cock in one direction, admit compressed air to the supply tank and the level of the solution in the rheostat tank will be raised and the load increased. By throwing the handle of the three-way cock in the opposite direction, the air in the supply tank is released to the atmosphere, the water in the rheostat tank runs back into the supply tank and the load is decreased. Thus, by the operation of the three-way cock the load may be adjusted to any desired quantity. One three-way cock is used for each of the rheostats above mentioned.

In conclusion, it may be noted that practically all the time since its installation, the plant above described with the assistance of one 50-h.p. unit has carried its load of 250 to 450 amperes with but few interruptions and with but minor difficulties.

The Motive-Power Officer.*

BY G. M. BASFORD, AMERICAN LOCOMOTIVE CO.

There is a remarkable fascination about a big, powerful locomotive. When it stands at the head of a train ready to depart, or when a magnificent train passes at a high speed, or even when a locomotive stands at the gloomy roundhouse waiting its turn for the service necessary to put it in condition for another run—we stop for an interested, admiring look.

The locomotive is worthy of the admiration and the respect of all, for it represents a development which has changed the form of human life, and it is one of the greatest influences for good that the world has ever known. The thought of what the locomotive has done is an inspiring one, and yet there is more to come.

Those who are interested without understanding are fascinated by the power and majesty of the machine. They see only the surface and are mystified, but those who understand the difficulties and appreciate the possibilities, are inspired, because they see that the present is but a beginning, with a wealth of opportunity for the future.

In the belief that there may be one or more present today who will act a leading part in the future, an attempt will be made to indicate some of the principles which may become important.

Our railroads are established and the country depends upon them for its very existence. They were built to meet existing needs and were extended to create new ones until transportation now becomes our most vital necessity. The struggling enterprises of early days have given place to great and powerful combinations, and the crudities and expedients of the past must give place to the perfection of construction and methods which congestion of traffic necessitates. The traffic of a single district—Pittsburg—today would have swamped all the railroads east of the Mississippi

*An address delivered before the Mechanical Engineering Society of Purdue University.

river at the time of the Civil War, but congestion is not the only factor to be dealt with. Wages are advancing, and rates are dwindling as a natural result of irresistible forces.

THE LOCOMOTIVE PROBLEM.

American railroads are usually built along the lines of least financial resistance and improvement problems in grade reduction and curve rectification were handed down to the present generation of managements. Improvement in yards, at terminals and at points in transit simplify the handling of freight, and soon the locomotive will receive its share of development. Heretofore it has grown chiefly in size, weight and power, but there remains another development in the direction of crowding the greatest possible capacity for power within the possible limits of weight and size. Economy of operation, while important, is less important today than the provision of the utmost possible capacity of the machine. Perhaps this may be more clearly stated by saying that the greatest need is for that which will extend to the utmost the capacity of the fireman and render capable of supplying the requisite power, the limited physical strength of a man.

This is the locomotive problem for the immediate future—to provide more power without greatly increasing existing weights. A secondary but scarcely less important field for effort is the improvement of design and method of operation which will reduce road-service failures.

THE SHOP PROBLEM.

Another opportunity for the greatest abilities lies in revolutionizing methods of motive-power management to bring them into parallel with those methods which have brought the greatest successes in the management of vast industrial establishments. Altogether the motive-power problem presents possibilities as great as those of any field of mechanical activity, and these are worthy of the efforts of the best of men.

THE CHANGED CONDITIONS.

Thirty years ago the head of the mechanical department led a comfortable life. He could safely follow precedent, and the strenuous life had not been invented. Labor wars had not begun, and the stirring emergencies of the present were unknown. It was easy to select shop machinery. There were no shop problems, no pooling of locomotives, no piece-work price, no heavy locomotive or large-capacity car and no train four-fifths of a mile long. No one cared much about records of performance or cost of work. Workmen were better trained and good apprentice systems were in force. There was no tendency to go outside of a railroad organization to secure any official, and railroad ways and methods were those of smaller days. There were emergencies, of course, but not the emergencies of today. Thirty years ago the railroad official was a good man and as efficient for the time as the official of today, but he was a very different kind of official. His facilities were crude, and his responsibilities were not so great. Locomotives did not weigh 50 tons, and other factors were in proportion. The superintendent was his own general manager, and he knew every man in the train service. The master mechanic knew all his shop men and the engineers and firemen; he knew their history and he knew all about them and their affairs. Each locomotive had a name and an engineer and fireman were assigned to it. They went into the shop with their engine, or they were laid off while it was repaired.

We have no desire to return to the old methods, but these methods are now worthy of a thought because, while all conditions of service have greatly changed, we have not changed enough in our views as to the proper management and organization of the motive-power departments. The past has left us a somewhat unfortunate legacy, of which the result only needs attention on this occasion. The result referred to is seen in the tendency for young men to be easily enticed away from railroad service after they have spent years in preparation for it and are fairly on the road to win success. As a legacy of the earlier days of railroads in this country motive-power positions are not, as a general rule, made sufficiently attractive. This, however, is to be changed, and the power to bring the change lies in the young men who now hold responsible motive-power positions, and in those who are to hold them in the near future. As motive power problems and possibilities become better appreciated and better understood, the railroads will surround motive power positions with greater attractions which will eventually render it thoroughly worth while for the very best mechanical talent to prepare for the work which, because of its attractions will preserve this talent to the railroads. There are signs on the horizon today that this happy state is coming soon.

SOME QUESTIONS WHICH ARE PRESENTED TO THE MOTIVE-POWER OFFICER.

As to the locomotive problems of the present we have a few like these—Shall the next lot of passenger locomotives be single or double expansion? Shall we experiment today with superheating? Shall we order balanced compounds? Shall we not adopt improved valve gear? For the next very heavy freight locomotives shall we order articulated compounds? Shall we brave the criticisms of those who worship simplicity, and order really better locomotives, even if a few complications are involved? In the shop problem, shall we or shall we not organize and operate large manufacturing enterprises successfully? In the next order for 10,000 cars, shall we use all wood, all steel or composite structures?

These are five questions, and those who are to decide them need to understand the reasons why they are presented and why they are pressing.

SIMPLE OR COMPOUND LOCOMOTIVES?

Shall the next lot of passenger locomotives be single or double expansion? Compounds, because of their favorable use of steam by dividing the range of expansion and the range of temperature change in the cylinders, are more economical in the use of steam than are the simple engines. This improves the efficiency of the locomotive as an operating unit, which is more important than economy. There is less cylinder condensation in a compound because the division of the expansion between the two cylinders reduces the range of temperature and therefore reduces the amount of moisture condensed from the incoming steam for the next stroke. A further advantage in the use of compound cylinders which applies to the three- and four-cylinder types lies in the fact that the steam is divided into smaller instalments, and not so much steam is required to pass through a given number of steam ports and passages. This renders a three- and four-cylinder compound "quicker on its feet" than single-expansion locomotives of the same capacity, and, as a matter of fact, the highest speeds in regular train service in the world are made with compound locomotives.

It may seem strange, in view of the superior economy of compound locomotives, that they have not been adopted generally in place of single-expansion locomotives. Compounds are apparently increasing in favor at the present time, and this is to be explained rather on the ground of the increased capacity which they render available than because of their superior economy. It is claimed by those who have used compounds and discarded them that the additional cost of maintenance, because of the somewhat increased complication, more than offsets the advantage gained by saving a little fuel. While this may have been true some years ago, it is not believed to apply to the more recent types of compounds and it may even be claimed at the present time that the feature of economy may be disregarded. This is because of the very much more important attribute of the compound in supplying increased capacity. At the present time railroad men are so anxious to secure the utmost possible capacity that they are willing to accept some additional trouble and expense in maintenance in order to secure the additional power which every railroad now requires in order to deal with trains of increasing weight and speeds. Reliability of service in summer and winter is now becoming very important in competitive passenger service. For this, reserve capacity is necessary.

When a railroad official faces the increasing weight of trains and increasing

severity of schedules, he is ready to grasp at anything which will help him out of his difficulty. Because compounds do increase capacity, young men who are now preparing to enter motive power service will find it advantageous to have well defined opinions as to the possibilities of the compound to meet future requirements which are going to be more difficult than those of the past or present. When the question of locomotive design is raised on a railroad where an additional car must be hauled and the time must be somewhat shortened, the compound locomotive lies ready at hand to meet this need. Those who are most competent to judge believe that the locomotive of the future is sure to be a compound.

SUPERHEATED STEAM.

Shall we experiment today with superheating? Superheated steam offers a very attractive field in connection with locomotive development. In German practice it has been remarkably successful and the Canadian Pacific Railway has practically duplicated the satisfactory results obtained in Germany. A number of experiments are now being made in this country, promising very satisfactory results. In short, superheating is one of the fundamental questions in locomotive practice which is worthy of most careful attention at this time.

Superheating does not seem to be antagonistic to compounding, but it serves in the same general direction to reduce heat losses in the cylinders. Condensation of steam in locomotive cylinders and passages robs the locomotive of a great deal of its power and, in cold climates, this becomes a serious matter. It will always be difficult to thoroughly protect the cylinders and steam passages from radiation and therefore other precautions may be necessary to prevent the loss of heat from the lessening power of the locomotive. Superheated steam, coming into the cylinders at high temperature as it does, permits of a larger loss of heat before producing condensation than is possible with saturated steam, where the margin for loss without condensation is very small. Superheated steam may lose to the cylinders and passages a much larger proportion of its heat before condensing, and in this lies the chief advantage of its employment. Superheated steam is also quicker than saturated steam in its movements through passages and ports, as is proven by the fact that in Germany seven-inch piston valves suffice for ordinary passenger locomotives.

Such a principle as this cannot be applied to a locomotive without incurring some trouble and expense. While the improvement in the efficiency and economy of the locomotive is very readily attained, it is quite possible that it may be attained at too great an expense in the way of restricted mileage and cost of maintenance, and it is always necessary to nurse a new development in order to make it practically successful. The question at the head of this section should be answered in the affirmative because the possibilities of superheated steam at the present time seem to be exceedingly important and it is perfectly safe to spend the time and money necessary for experimenting because of the practical certainty of the results.

BALANCED COMPOUNDS.

Shall we order balanced compounds? The subject of balanced compounds really requires a paper by itself. Locomotives have become too large to permit of continuing indefinitely the mere increase of size and weight. More scientific development is needed. The usual methods of counterbalancing answer very well for comparatively light locomotives, but as locomotives become larger and the parts become heavier the internal stresses upon the engine itself, due to the inertia of the parts, and the effect upon the track of the unbalanced counterweights, render it necessary to devise a better scheme of balancing. In ordinary practice counterweights are added to the driving wheels for the purpose of balancing the reciprocating parts, but the revolving weights themselves need balancing when near the top and bottom of their paths. When in these positions the counterbalance weights tend to change the weight on the driving wheels, due to their centrifugal action, acting vertically upward when the weights are near the top of their path, and acting vertically downward when they are near the bottom. The counterweights, therefore, tend to lift the locomotive in the one case, and tend to increase the weight on the rails in the other case. This causes the so-called "hammer-blow" upon the rail, and because this so-called "hammer-blow" sometimes amounts to 25 per cent. of the static weight on the rails, it becomes exceedingly important in limiting the weight allowed upon driving wheels. By using four cylinders and balancing reciprocating parts with other reciprocating parts, and revolving weights with revolving weights, a practically constant pressure on the rail is secured which renders it permissible to increase the weight on the driving wheels without increasing the destructiveness upon the track. By this permissible increase of driving-wheel load a larger boiler may be carried, which is greatly to be desired in locomotive practice today.

On the Pennsylvania testing plant at St. Louis the Cole four-cylinder balanced compound operated for a full hour at a speed of 75 miles per hour, thus indicating a remarkable capacity. Incidentally economy of fuel and water constitute attributes of this type of locomtive, and in the constructive features it is found to be possible to materially lighten the parts because the work is divided among a larger number of them. The subdivision of the power reduces the fiber stresses on each of these parts and the disturbing influences of very heavy rods and reciprocating parts are avoided. The effects of reciprocating parts upon the structure of the engine as the movements of those parts rapidly change in direction, has probably never had the attention which its importance merits. For high-speed passenger service, and also for freight service, the four-cylinder balanced locomotive presents advantages which should be tested to the utmost.

VALVE GEAR.

Shall we adopt improved valve gear? Many efforts have been made to improve locomotive valve gear. These have been directed toward an improvement in the distribution of steam, and also to improvements in mechanical construction. Entirely aside from possible improvements in the distribution of steam, the valve gear of American locomotives of very large size presents an opportunity for structural improvement which, at the present time, is extremely important. The present tendency toward the use of Walschaert valve gear is due chiefly to the desire to improve structurally rather than to improve the use of steam. It is considered advisable to remove the valve gear from a confined space under the locomotive and also, if possible, to lighten the parts and arrange them in direct lines. The Walschaert valve gear does this, and more. It substitutes easily maintained joints and pin connections for the very large and inaccessible eccentrics, and it provides an arrangement which is not as liable to derangement as is the Stephenson motion.

ARTICULATED LOCOMOTIVES.

For the next heavy freight locomotives shall we order articulated compounds? Heretofore the locomotive has grown generally in size and weight, without radical change in principle to meet the conditions of growth which cannot properly be made through the application of the brute-strength idea in design. Large freight locomotives of ordinary types now involve single parts so large as to be difficult to handle in the shop. Their very size gives evidence of the stresses to which they are subjected, and it is believed that the time has arrived for dividing the power and work of the freight locomotive into a larger number of parts, as is done in the case of the Mallet articulated compound, which has now been successfully running for over a year on the Baltimore & Ohio Railroad. This locomotive weighs 477,000 pounds, including tender, and is the heaviest and most powerful ever built. A glance at this enormous machine immediately indicates the absurdity of designing it upon the basis of two cylinders. This locomotive has operated so successfully as to practically establish the principle of the articulated compound for locomotives which are not nearly so heavy. This general subject of large freight locomotives is one which

now needs, and will continue to need, the attention of those who are preparing to deal with the problems of the next few years.

These questions are not today always placed before motive-power men for final decision; but these are some of the real mechanical-department questions which motive-power men should be permitted to decide, and if they are decided by the right men, many factors of railroad operation will be revolutionized. To the future other questions may be left, but the answers must not be long delayed.

PERSONNEL.

It is necessary to decide upon suitable recruiting methods, upon improvements in organization, and methods of dealing with the rank and file as well as with the officers and subordinates, to produce a stream of developed talent toward the shop, where it is soon to be more greatly needed than ever before.

ELECTRIC LOCOMOTIVES.

What is the locomotive of the future to be? It will be a steam locomotive for a time and then electric. In many places traffic is now sufficiently congested to render electric locomotives attractive; but before the steam locomotive becomes a mere curiosity there remains much for it to do, and its development and its improvement are by no means ended. The electric locomotive, however, is an entirely new problem.

THE LESSONS TO BE LEARNED FROM EUROPEAN PROGRESS.

As yet comparatively little has been done in the improvement of the locomotive in this country in the direction of superior economy and efficiency. In Europe the high price of coal has led to care in design and in operation of locomotives which is unknown here. The French are a generation in advance of us in locomotive operation. In France locomotive engineers use devices such as double valve-gears and variable exhaust nozzles, which we do not intrust to our engineers and firemen. In England the small number of locomotive failures on the road are a revelation to anyone who studies them from our standpoint. In England the locomotive is given a fair chance by receiving fair treatment, yet it probably does not cost more in the end. We certainly have much to learn from across the water, and while what we may learn is not so much in practice as in method, it is none the less important. That which we most need to learn from England is the value of appreciation of the locomotive and locomotive men. This will be learned and well learned—probably in the near future, of this we may feel sure. We may safely count that when those who are now students are ready to be leaders of mechanical departments of our railroads, the position of the department head will have become an enviable one. There is no field of mechanical work so full of opportunity as this and much depends upon those who are now fitting themselves for the leadership of tomorrow. These leaders may now be in the ranks; they may be in the colleges, but wherever they are their preparation must be thorough, for their work is to be great and it will grow to be still greater.

ENLARGED RESPONSIBILITY.

The idea of the importance of the mechanical problem when demonstrated on a large scale is suggested by the fact that January 1, 1906, a combination of 54 railroads controlled by the Vanderbilt interests became known as "The New York Central lines." All cars, stations, locomotives and all the office stationery used in transacting the business of these 54 roads will bear this name. This enormous combination of responsibilities is not as impressive in any other of its phases as it is in the matter of the motive power responsibilities. The question of design and of construction, of locomotives and of shops and many other questions which are comparatively small on the individual roads of this combination now become great because of the effect of the practice in one portion of the system upon that in another. It is easily understood that such an aggregation of interests renders it necessary to prepare, through careful study, for every change in practice. The design of shops cannot be made without most thorough and careful consideration of practice in other parts of the system made with the view of adopting the best in every detail, and the same applies with even more force in the case of locomotives. All this points to the necessity for very high authority to properly administrate those responsibilities. In this discussion only the high points are touched upon, many others being unmentioned because of the lack of time.

There seems to be no need of arguing at this time in favor of placing full and complete authority for such important problems in the hands of an official who stands immediately next to the throne. This, when done, will mean much to American railroads.

During the last ten years motive-power progress has been rapid because of the change in operating methods brought about by the large train unit. This has brought advances in weight and power which are startling, and the roads are not too well equipped with either physical facilities or men. Some radical changes are necessary.

THE IMPORTANCE OF THE ROUNDHOUSE AND SHOP.

The "roundhouse foreman" as a designation of position has become outgrown, and the men required for the responsibilities of large and busy roundhouses cannot much longer be called foremen. They must be master mechanics, or the equivalent, because these positions have become more vitally important in the conduct of the railroad. The time has come for entirely separating shop and road responsibilities of subordinate officials. The larger shops require shop superintendents, and the conditions requiring master mechanics to properly look after enginemen, firemen, roundhouse forces and the shops, as a combination, passed away some years ago.

Motive-power work is divided into three distinct fields. First, the shop problem. Second, the locomotive-operation problem, including roundhouse service. Third, mechanical engineering.

To be successful in either of these, wide experience is necessary. It is into the engineering branch that technical-school graduates are most likely to drift, the work being agreeable and being very closely related to the student's work at school.

Without in any way reflecting upon the opportunities offered in the line of mechanical-engineering work, it should be said that experience either in the shops or in the roundhouse is important for a young man who is to succeed. It seems desirable to positively recommend young men to delay entering the engineering work until they have had experience in one or both of the other branches. If they are by temperament and ability qualified for either shop or road administration they will learn this fact most easily and quickly in connection with the actual work, and if they are better fitted for engineering problems they will be better able to handle them later on because of the road or shop experience. It seems, in general, desirable for most young men to avoid the drafting room immediately on completion of their college work, and it is believed that in this most railroad officials will agree.

A word seems to be needed as to progress. In studying the careers of successful men a prominent fact is developed which seems specially applicable to a successful railroad man. Those who have really advanced most rapidly and have risen highest have usually advanced slowly during the first dozen years. It is believed that an attractive future has been pictured for those who prepare and equip themselves in the right way to carry the mechanical railroad burden of the future. It most assuredly will pay to prepare thoroughly and well, for those who do this are sure to be greeted with most brilliant opportunities. In order to prepare thoroughly and well, however, years of experience are required.

The railroads themselves have not done as much as they might to provide the leadership talent which is so well known to be required for the future. It is, in fact, on many roads left for the young men who now enter the service to correct this, and they can do so by thoroughly preparing for their work.

No future is brighter than that which is offered in this part of the field of trans-

portation, and it is hoped that some may be present who are to win in this great game. Nothing that is easy brings satisfaction in doing, and if difficulties are a measure of satisfacton, there is an abundance of satisfaction in this work.

For young men to succeed it is merely necessary to "make good." Every railroad official is looking for young men who may be trusted to do things. The official does not need to be told who can do them. A young man makes his record by his work itself. He should seek opportunities to do things that somebody wants done, and in this way will become sufficiently conspicuous to attract attention. Of these opportunities motive-power work is full to overflowing.

I believe in the motive-power officer, in his opportunities, his possibilities and his ultimate success in becoming an executive and administrative official instead of remaining as a chief of a department.

"It is the ship with its bunkers full, its engines tested, its captain forewarned, its straight-line voyage charted, that breaks the record into port."

"And it is the minute of talk after the hour of thought, the ounce of effort after the ton of preparation, that steers a business project into the harbor of success."

The Waterbury (Conn.) *Republican* states that an industry which has been monopolized practically by Waterbury is to be lost to that city as a consequence of a recent Government decision. This is the manufacture of blanks for copper cents, of which coins nearly 7,000,000 are made every month. The United States Treasury has taken over the business from the private concerns. The blanks used to cost the Government 24 cents a pound; but today, owing to the rise in copper, they cannot be manufactured for less than 29 cents. A pound of blanks represents 146 pennies. If a cent a pound be added for the expense of stamping them with dies, it will be obvious that Uncle Sam is able to manufacture 486 pennies for a dollar, and these he disposes of for $4.86. Of course he is under the obligation to redeem them at their face value whenever returned to him; but comparatively few are returned, and many of them are lost. The so-called copper cents are really of bronze, having 3 per cent. of tin and 2 per cent. of zinc, this alloy being employed on account of its hardness, durability and retention of polish. The blanks have been made by the Scovill Manufacturing Company, of Waterbury.

The new Hotel Belmont at Forty-second street and Park avenue, New York City, will, it is said, be the first hotel in the world to have a wireless telegraph station. Upon the roof of the hotel, which is 300 feet above the level of the street, a staff 150 feet high will be erected.

Some Stepping Stones in the Development of a Modern Water-Wheel Governor.*

BY MARK A. REPLOGLE.

INTRODUCTION.

In the preparation of a paper to be presented to the Franklin Institute in the year 1897, I was permitted to discuss either "Speed Government in Water-power Plants," or "Water-wheel Governors." The former was chosen. The paper was read before the Institute on December 14, 1897, and was published in full in the *Journal* of the Franklin Institute, Volume CXLV, No. 2, February, 1898. It represented the gleanings from my eight years' experience while trying to successfully govern water powers, or rather turbine wheels.

Up to this time a number of different types of governors had been devised and put into service, but I had not made sufficient progress to warrant any conclusive statements concerning my developments. Another eight years has passed during which time much hard work has been done, and the results of this period are of a more definite character.

A mechanical governor has been developed. Some of its principles are unique, and some of its actions are remarkable. It is my intention to show some of the steps that led up to the development of this mechanism, as well as to describe the machine, and some of the principles that enter into its construction.

In the Franklin Institute paper I made the following statement: "A properly constructed governor must open the water-wheel gates as fast as gravity can follow with water; no faster. It must close the gates slow enough to insure safety to the penstock; no faster. It must be capable of stopping the gates at any degree of opening. It must be endowed with the relay principle adjusted to co-operate properly with the power storage.

"It must not be a separate and independent feature of the plant, but must be made a part of the plant in an intelligent manner; at best it is only one of the factors in the government of a water-power plant. It must be remembered that all the governor can do is to open or close the gates as the variations in speed require, and no water wheel can be governed successfully by varying the gate openings, unless the same principles are adhered to that make government in steam engines a success."

This very general statement pointed out the work to be accomplished. This paper, while adding some new requirements, will be devoted *mainly to showing how to obtain the desired results.*

ELEMENTS OF A WATER-WHEEL GOVERNOR.

A modern water-wheel governor must have four distinct elements; 1st, the speed-control element; 2nd, the gate-moving element; 3d, the temporary speed control influence; and 4th, the permanent speed control influence.

The control element in a modern water-wheel governor is a centrifugal speed governor. Its function is to trip or put into action the gate or valve-operating apparatus. This element is affected by, 1st, variation in speed of the turbine; 2nd, the temporary-control influence; and 3d, the permanent-control influence.

The gate-moving element provides the power necessary to operate the wheel gates, and can open or close them as necessity requires. This element may be a pawl and rachet device, a clutch, a shifting belt, a hydraulic ram, or a variable speed transmission. This element can use any convenient power supply, but the control element must always be driven by the water wheel to be governed, if speed regulation is required.

The temporary-control influence is used to cause the governor to anticipate the effects of water added, so as to prevent the condition known as hunting or racing. This element may be of hydraulic or mechanical construction, or a combination of both. The permanent-control influence is for the purpose of running several power units in multiple, causing an equal distribution of load.

Before proceeding further, I wish to make the following statements: A good water-wheel governor must be able to move the gates slowly or rapidly, as necessity requires. This discrimination savors of good judgment. A good governor must always stop operating before the speed has reached normal. In fact, it ceases to operate at a speed that is farther from normal than that necessary to cause it to begin operating at the start. This is "judgment." A good governor always ceases to operate before the speed has returned to normal; sometimes it ceases a shorter time before the speed is right; and again it ceases a longer time before the speed has exactly reached the normal, but always just long enough ahead of time to allow the speed condition to be right after the inertia effects of the water, the new load conditions, and the new power conditions are balanced. This would be called an act of reason if performed by a man, a horse or a dog. Is it less so if performed by a machine? The perfect governor can place the water-wheel gates in position ahead of time with a precision that could not be reached by the designer of the machine if he had to do the governing by hand.

In order to pave the way to a fuller conception of the new governor, I can think of no better course than to show by some simple illustrations a few of the important stages in its evolution.

ACTION OF GOVERNOR AND WATER WHEEL.

Before going into these details, it will be necessary to get an idea of the nec-

*A paper read at the Chattanooga meeting of the American Society of Mechanical Engineers.

essary action of a governor as compared with the speed and other conditions of the turbine and power-plant effects. I will, therefore, aim to show graphically in the diagram, Fig. 1, the relative time of the governor's actions as compared with the time of changes in load and speeds. A careful study of this diagram will reveal the fact that a good governor must be possessed with powers that closely resemble reasoning. I will add further that the actual conditions as shown by the diagram were not understood in the earlier years of my governor work.

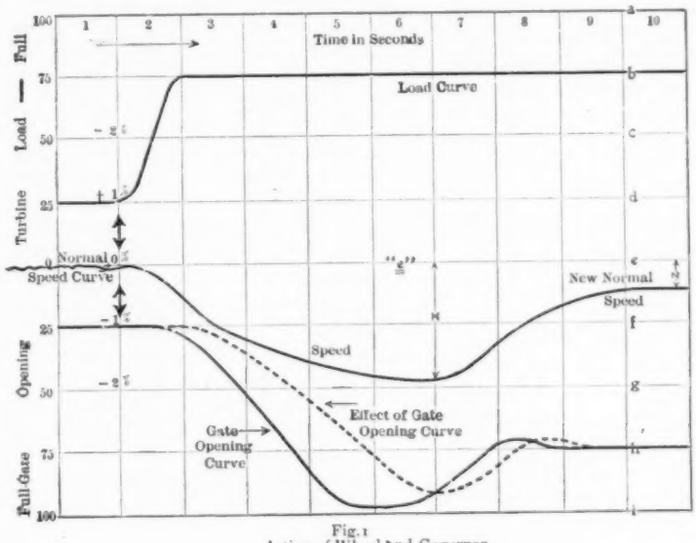


Fig. 1
Action of Wheel and Governor

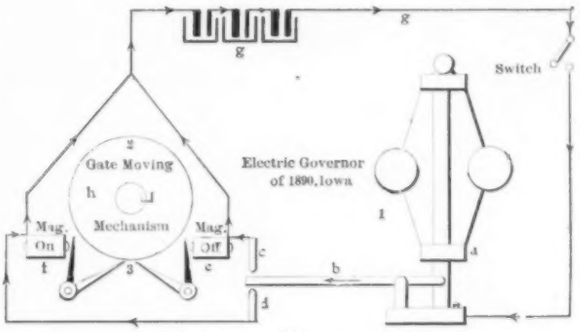


Fig. 2
Three Stage Governor

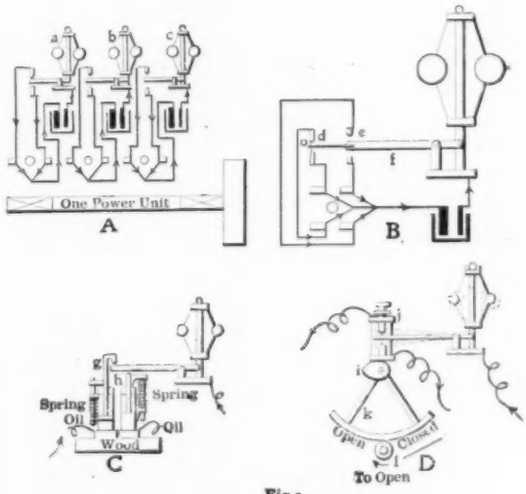


Fig. 3
An Arrangement of Three Governors

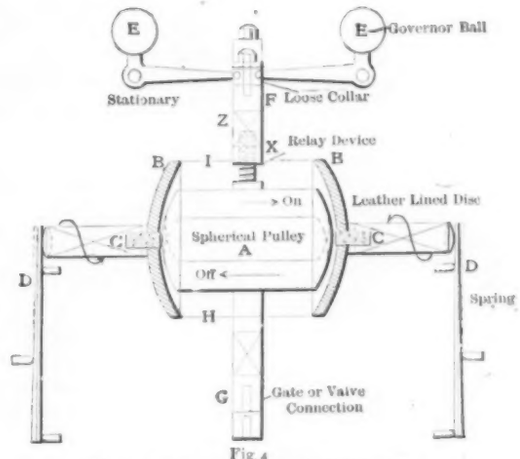


Fig. 4
Principle of the Lombard-Replogle Governor

In order to make the necessary comparisons in Fig. 1, the ordinates 1, 2, 3, etc., divide time in seconds; the abscissas *a*, *b*, *c*, *d*, etc., represent load above the line *e*, and the gate opening below *e*. For further convenience *e* represents normal speed, while *d* and *c* represent 1 per cent. and 2 per cent. respectively above speed, and *f* and *g* represent 1 per cent. and 2 per cent. below normal speed. The load curve can be noted in the upper half and the gate-opening curve in the lower half of the diagram. *X* represents the temporary drop and *z* represents the permanent drop in the governor's operation. Beginning at the left, it will be noted that up to the beginning of the second second the load is 25 per cent. of full capacity; the speed is zero or normal, and the gate opening is also 25 per cent. of full. At this point 50 per cent. of the full load is added, requiring a full second of time, as shown. The speed begins to drop at the instant new load is added, but as it must vary enough to throw the governor into action, there is no gate movement until about the middle of the second. Then, as gravity must have time to overcome the inertia of more water, there is no power added until the beginning of the third second. (The dotted line shows the gate effect, which is always after the time of gate movement.) By the middle of the fifth second the gate is nearly open, and remains almost stationary for almost one second. The speed, however, keeps on falling until the beginning of the seventh second. (Please note that it is the *effect* of the gate opening that does the governing, and not the amount of the opening; also that the governor ceased to open the gate one and one-half seconds before the speed ceased dropping, and fully five seconds before the speed had risen to the new normal condition, which is one-half of 1 per cent. below the original normal speed.)

If the governor had kept opening the gate during all the time that the speed was below normal, the speed would rise far above normal by the time the full effect could be realized, and the result would be an over-running or hunting.

The momentum of the power unit has a great deal to do with the rapidity of drop in speed when a load is added, and the hydraulic conditions have a great deal to do with the difference in time between the gate movements and their effects. Both of these conditions, while they affect governing materially, are in no way determined by the governor man. A governor must be capable of adjustment to the various turbine conditions, or failure will result.

STAGES IN GOVERNOR EVOLUTION.

Having shown what a good governor

must be able to do, I will now proceed to show some of the steps leading up to such a machine, referring, of course, to my personal experience. My first governor patents contemplated a mercurial speed governor, but on account of being able to procure a very good mechanical speed governor to use an indicator of speed conditions, the mercurial governor was never used. The majority of governors in use in the United States, in 1890, were of a simple two-stage type. That is, the movement of parts in the centrifugal element would trip or set into action the power, or gate-moving elements. This class of governors would continue to shift the wheel gates as long as the speed was sufficiently far away from normal to cause the governor to act. Observation made it plain that it required from 2 to 5 per cent. variation in speed to cause such a governor to begin operation; therefore, in order to save the time lost in getting such a governor into operation, a three-stage governor was made. The novel features of this machine will be noted in Fig. 2.

In the diagram *a* is the speed governor, *g g* a battery with its circuit, and *h* the gate-moving mechanism. With this combination a variation of 1 per cent. or less in speed was sufficient to close the circuit at *c* or *d*. This in turn would energize magnets *e* or *f*, causing them to put the gate-moving mechanism into motion. This governor was an improvement on the old type governors, as it utilized the most valuable time by beginning its operations long before the old governors had varied enough for action. This machine required from one to five minutes to move the wheel gates from end to end. Any attempt to operate the gates in faster time resulted in over-running and hunting. I learned from this governor that the effects of gate opening always come after the operation; and I concluded that a governor to be a success must "anticipate" the load variation. This seemed impossible, but I felt there was room for improvement; therefore, I studied water powers carefully for several years. The result of this special study was a discharge gate governing apparatus in connection with the above electrical governor. Discharge gates were not always practical; therefore, were abandoned after several fairly successful installations. The great point desired was faster gate movement, with no racing or hunting effects. I might add that discharge gate governing, in effect, was changing the head on the turbines at the same time that the quantity of water was changed. In other words, power was added in double the ratio of the ordinary methods, and the water-hammer effects were no greater. The racing effects were less because the gate effect followed its movements more promptly.

COMBINATION OF GOVERNORS.

The illustration Fig. 3 represents about two years' experience. *A* represents three speed governors, each one actuating a gate regulator. The three turbines thus governed were all belted to one line shaft, making one power unit. The principle to be brought out by this combination may be called cumulative or differential gate movement. Speed governor *a* would cause its respective turbine gate to operate at 1 per cent. variation from normal. Speed governor *b* would begin operating at 2 per cent. variation. Governor *c* would cause its gate to operate at 3 per cent. variation; therefore, when a change of load would occur that would vary the speed as much as 3 per cent., all three governors would act, and the combined action was supposed to be fast enough to take care of the extreme changes of load in an electric railway power plant. The advantage of this scheme was a slow addition of power when the speed varied a little, and a rapid addition of power when a heavy change in load was made. This plan reduced the racing effect, even though a faster gate movement effect was used. Viewed from present-day knowledge there is nothing brilliant in this combination, but it taught me the value of differential gate movement, and as a matter of history it was the means of governing the first automatically regulated water-driven electric railway in the United States. The guarantee made to the owners of the water power was: "Better regulation than could be given by a man at the hand wheels." It was conceded that I had met the guarantee, and payment was made for the three governors.

In *B* one speed governor inspires two gate regulators, or one double regulator by means of contacts *o* and *e*. The flexible tongue *d* allows lever *f* to make a second contact with a greater variation in speed similar to action shown in *A*.

In *C* contacts *g* and *h* are attached to the piston rods of dash pots or cataract cylinders. They were so arranged that when the speed governor would touch the contact the regulator would act and the pressure would force the piston through the oil as long as the speed varied from normal. A small spiral spring would cause the piston to return slowly to its former position after a change of load was made. The effect of this scheme was to cause the governor to act while the speed was going away from normal, and then by breaking the circuit the governor would stop acting, so that by the time the effect of the gate action was fully realized the speed would be returned to normal. This was the first device that I had ever used that would anticipate or make provision for the effects of the gate action coming after the gate movement. By a proper balancing of piston and spring a faster gate action could be employed without racing effects. This was an important stage in the development, as it taught me that a machine could be made that would operate the gates only while the speed was varying from normal, and the contacts could be made to return to their original position, fast or slow, as the power storage effects of the plant would permit. Here was a crude relay governor, but I failed to ever find anyone else who could adjust it as satisfactorily as was desired. I was therefore compelled to devise a more positive and reliable means for accomplishing the same purpose. In *D* the cam *i* forms a support for contact-bracket *j*, which rises or falls by means of segment *k*, driven by gate-shaft *l*. With this device the governor would turn on water as long as the speed would drop, and would turn off water as long as the speed would rise. This permitted a more rapid gate movement without the racing effects being so marked. Here was a relay governor that offered an opportunity to operate wheel gates rapidly and in a great measure prevented overrunning; that is, in plants that embodied sufficient momentum in their revolving parts. But a new difficulty arose. A governor that could operate wheel gates from end to end in one-half minute must be four times as powerful as one to do the work in one minute, and it must be one hundred times as powerful if the work must be done in six seconds. Therefore, a new and more powerful series of governors had to be built. It was also learned that where power plants lacked in momentum the cam *i* had to be so steep to prevent racing that the permanent drop in speed caused by it was too great for good automatic regulation. This was in a small measure remedied by making a differential cam to compensate as economically as possible with the variable effects of the gate openings. (Power is added fastest at the earliest stages of gate openings.) Therefore, the cam required greater drop on the start and decreased rapidly as the gate opened. To overcome this large drop I had to devise a goverror that would permit the necessary drop in the first operation of the governor, while a secondary operation would permit a slow returning of the members to their original positions, and in doing so the governor, without change in speed, would operate on the wheel gates until the speed was correct. This governor was called a Relay Returning Governor, an anticipating machine. In making this governor it was necessary to perform so many of the functions mechanically that the electrical features were cut out of the governor entirely, necessitating another series of new governors. (There were other considerations that made it seem best to drop the electric battery and its circuit.)

It can be truly said all of the work up to this point was preliminary. I had merely learned the rudiments of successful water-wheel governing. These first principles had to be developed in order to know fully to what extent they could be employed under the many conditions of

governing that are encountered in practice. The above constituted the first eight years of governor experience, and shows the development up to the time of preparing the paper for the Franklin Institute.

The past eight years have been devoted to the development of a machine that embodies the elements necessary to perform its functions in the proper ratios. I will state broadly that no two turbine installations govern alike, and the perfect governor must be susceptible of a greater range of adjustment than any other known machine. Its "reasoning" power must be prescribed for every power plant that it is placed in. That is, it must "anticipate" the rapidity of gate movement, as well as the point the gate should be moved to, for every change in load. Both of these judgments must be performed before the speed has begun to return to normal. It must then hold itself in suspense until gravity has fully charged the new water added with power, and this power is extracted by the turbine. If the speed returns to normal too fast or too slow, it must of its own volition shift the gates to a new point of opening. Here are four distinct acts of judgment that may take place in one change of load, and a smaller or larger change of load will require a change in all of the ratios. The above describes a simple change in the load of a turbine. In case a second or third change in load should occur before equilibrium for the first change has been established, it is very apparent that the governor's actions must be further complicated. As stated before, a perfect governor must act with a precision not often found in the most studious man.

DEFECTS IN THE POWER PLANT.

A few suggestions at this point will not be out of place. If a most perfect governor were attached to a turbine plant, it will not always assure perfect regulation, and some of the defects found by the governor man are given in Table 1.

Any one of the above defects will cause erratic action in the governor, and on account of some strange fatality the governor often gets full measure of credit for any or all of them. Space forbids discussion of Table 1.

Table 2 shows an aggregation of some of the more important conditions found in the power unit and some of the more important features a good governor must have, and by way of explanation will say that the word differential is intended to convey the idea of a constantly increasing or constantly diminishing motion, or effects can be more accurately illustrated by the use of parabolic curves. (These statements are made from the standpoint of time.)

Mechanical Defects.	*Hydraulic Defects.*
1. Unbalanced gates.	9. Long closed feed pipes.
2. Cramping or interfering in gates.	10. Contracted feed pipes.
3. Ponderous, unwieldy gates.	11. Short bends in feed pipes.
4. Lost motion in gates.	12. Slanting draft tubes.
5. Torsion in gate rigging.	13. Draft tubes too large or small.
6. Irregular effects of gatage.	14. Loss or gain of vacuum.
7. Lack in power storage.	
8. Obstructed intakes.	

TABLE 1.

Power Unit Conditions Due to Inertia.	*Requirements of a Good Water-Wheel Governor.*
1. Speed variations are differential.	7. It must be extremely sensitive.
2. Effects of gravity are differential.	8. Must have differential gate action.
3. Speed governor effects are differential.	9. Must have differential temporary cut-outs.
4. All load changes are differential.	10. Must have differential return movement.
5. Gate effects are not immediate.	11. Must have permanent cut-outs.
6. Power storage effects are differential.	12. Should be adjustable to all ordinary conditions.
	13. Should have adjustable permanent drop.

TABLE 2.

Type.	Capacity Foot Lb.	Time in Seconds.	Pulley Diam. Face.	Speed R. P. M.	Hight.	Base Dimensions.
L. R.–6	500	2	8″–2″	500	13″	19″ x 15″
L. R –10	5,000	4	14″–3″	500	22″	2′–7″ x 2′–1″
L. R –14	30,000	8	19″–4½″	500	2′–6″	3′–7″ x 3′–10″
L. R.–18	100,000	12	24″–5½″	500	2′–3″	4′–7″ x 3′–8″

TABLE 3. Water Wheel Governor Series.

THE PERFECTED GOVERNOR.

Such a governor has been perfected. In preparing the way to the introduction of this machine I have omitted the details, and have referred only to the more important experiments. The ideas preserved were selected on account of their having special merit at the time of their employment.

The foundation of the new governor is a sphere and disk transmission device. The practical limits of this device have been determined by eight years' experience. The physical make-up of the drive is the result of this experience, and has proven to be entirely satisfactory. In principle it is an application of the shifting belt and pulley. The only difference being that the pulley is shifted and the effect is a differential drive from a standstill to the fastest movement with full torque throughout its range.

Much experimenting has been done in the way of tripping or shifting devices during the past eight years, with various degrees of success. During this time the new drive came repeatedly to the notice of Nathaniel Lombard, a most successful designer of water-wheel governors. His fourteen years' experience in this work led him to believe that the ideal governor must be purely mechanical, and his search for a differential drive resulted in a combination; therefore the new governor is the result of our combined experience. Every member in its construction was the subject of a special conference, and it is the most perfect machine that our experience up to date has produced.

The governor in its simplest form is shown in Fig. 4.

In the diagram *A* is a spherical pulley with its shaft turned down and threaded as at *X*. *B* and *B* are oppositely revolving concave disks lined with leather. *C* and *C* are lignum vitæ pins flush with the leather. *D* and *D* are compression springs for causing the necessary pressure between the disks and the sphere. (Please note that when the sphere is shifted from center, in the line of its axis, the springs are tightened automatically, causing increased traction, as the smaller diameters of the sphere engage the larger diameters of the disk.) *E* and *E* are governor balls so poised as to require the weight of *A* to balance them at normal speed. *F* is a loose collar to allow independent revolution of the balls *E E*. *G* is the point of connection between *A* and the gates or valves of the motor to be governed. *X* is the relay device, and is for the purpose of preventing racing. Also for the purpose of properly dividing the load in parallel units. *Z* is a stationary spindle or connecting link between collar *F* and the threaded shaft or pulley *A*. *Z* is only stationary in reference to revolution, as it rises or falls with the variations of the governor balls.

The following is a description of the governor's action if the speed should drop by an addition of load: The lessening of the centrifugal effects on *E E* will allow *A* to drop below the centers of disks *B B*, which are constantly revolving in the directions shown in the diagram. As soon as *A* falls below the disk centers it will begin to revolve slowly to the right, being the direction that will turn on power. While *A* is turning to the right it shortens the distance to collar *F* by means of the thread at *X*. This shortening causes *A* to be pulled back to the disk centers, thereby cutting the governor out of action. It will be noticed that *E* and *E* have not shifted their position during the act of opening the valves. Therefore the speed is in reality lower after the new power is added than it was before the change in load. It is now clear that there is a continuous dropping in the speed while the valves are opening. In practice this permanent drop is enough to insure the correct division of load. It is also enough to permit of successful government where adequate power storage exists in the unit to be governed. In this governor there is no special provision for

temporary relay. Such provision is unnecessary except where the momentum effects are small. (In the governor shown the permanent drop can be varied by the pitch of the thread used at *X*.) In ordinary practice it is about 2 per cent., and it can be less in steam-turbine practice.

Before going further, it will be well to make some statement concerning the physical qualities of this governor. Experience has shown that we can secure 15 pounds pull per square inch of traction surface. The traction surface varies as the squares of the diameters, with the odds in favor of the larger drives. In all of our experience the traction increases with the age of the machine. (Its action perfects its shape.) The leather in polishing the sphere causes greater traction. It requires very little power to operate it at normal speed. The increase in speed from shifting *A* off center is not a constant increase, but a cumulative increase, such as is found necessary in accurate governing. The maximum speed of valves or gates can be fixed. In this drive or transmission the design can be varied so that the pulley *A* can make two revolutions to one of the disks. The possible variation in Fig. 4 is a range from zero to the same speed of the disks. Springs *D D* can be so proportioned that greater torque effects will be produced at the higher speeds. That is, since the disks are concave, they will be forced back against the springs as the sphere is forced from its central or normal position.

Experiment has shown that the pressure necessary to force *A* from the center is imperceptible until the concave surfaces begin to offer resistance. This tendency of the disks to press the pulley back to the center is in itself a valuable feature in a governor. (In effect it is temporary relay and is very reliable, needing no adjustment.)

Please note that the disks have a greater radius of curative than the spherical pulley. If the radius of the disks should be lessened, it will require a smaller movement of the pulley to bring about its fastest motion. Flatter disks will require a greater movement of *A* to produce its fastest motion. It will be readily seen that this drive or transmission is susceptible of a great range in design, and it is therefore adaptable to a great number of mechanical transmissions. It might be called a perfect cone pulley drive in a most compact and economical form. It is a variable belt and pulley transmission condensed.

The governor in this form is exceedingly sensitive to speed variations. Our experiments up to the present show that the governor will operate in either direction, with variations in speed too small to be indicated by the ordinary tachometer.

EXAMPLE OF GOVERNOR CONSTRUCTION.

Fig. 5 shows a plan view of a governor designed for the power house of the Sanitary District of Chicago. This governor is designed to develop 60,000 foot pounds of power in 8 seconds. The speed governor is in the driving pulley, and the disks are driven by belt. In this way we eliminate all gearing except the gate gears, and the small bevel gears necessary to move the sphere into action. This is a three-stage governor; that is, the power of the speed governor presses friction wheels into action, and they in turn force the power drive into action. The speed governor lever and the floating lever may be seen in the lower left-hand corner. In this governor the traction disks have a speed of 500 revolutions per minute. All fast running bearings are self-oiling. This machine is noiseless in all of its actions, and requires a very much smaller proportion of power for governing purposes than has ever come to our notice before. In other words, instead of a continuous use for governing purposes of from 1 to 3 per cent. of the total power developed, this machine will require less than one-tenth of one per cent. This consideration alone is worthy of attention. The power required to keep the machine in motion is very small, and when in action the only further power required is the additional power necessary to operate the gates at whatever rapidity is required. There is an enormous saving over that class of governors employing force pumps that operate against a pressure of over 200 pounds per square inch.

Fig. 6 shows an end elevation of the same governor. The rim of the drive pulley is removed in order to show the detail of the speed-control governor, also a portion of the permanent cut-out arrangement is shown. It will be noted that the idlers used to guide the disk drive-belt are located in the base of the machine. The scroll gear and the hand-wheel pinion are removed. The construction of the disk traction spring is also shown.

Fig. 7 shows a side elevation and shows fully the connection between the spherical pulley and the gate or valve shaft. The main shaft can operate at any velocity from standing to one revolution per second; therefore the governor can be geared to operate the gates in the smallest number of seconds that the conditions will allow. The pin clutch at the right-hand end of the machine indicates the manner of throwing the governor positively out of action. The lever under the hand wheel is for the purpose of throwing the transmission into action, independent of the control-governor. The slanting shaft in dotted lines furnishes the power to the temporary drop and time-element device. Its speed is varied by shifting the friction wheel near to, or further from the center of its driving disk.

Considering the many functions that must be performed, we believe this to be a most simple and perfect governor. The machine embodies the means for giving the necessary permanent drop as found desirable for the requirements of each power plant.

Table 3 shows a tabulation of capacity, etc., of the new Lombard-Replogle series of governors. It fully explains itself.

DASH-POT APPARATUS.

Fig. 8 shows a new invention used successfully where differential retarding or dash-pot effects are desired. This has been found very satisfactory during the past two years, and is a distinct member of a series of standard governors being manufactured. This apparatus embodies some novel ideas, therefore a short description will be given.

In section *X A* is a piston rod, having a piston *B*, with beveled edges or the corners removed. *B* is surrounded by the ring piston *C*. *C* is held in place by the lateral piston rods *DD*, and the yoke *E*. *E* is centered by collars *I* and *G* by means of springs *F* and *H*. *J* and *K* are adjusting collars for the springs *F* and *H*. The purpose of this member is to permit a rapid movement of the piston without any great increase of pressure between its extremes. A careful examination will show that this device has a collapsible piston that operates equally well in either direction. Its first action is that of the ordinary dash-pot up to a predetermined pressure, after that it gives way with a very small increase in pressure. This device has a large range of adjustment, and its function is to retard the action of the control element in a governor, so as to give gravity its time for action before the governor has done too much. By this cylinder the actions of the governor can be timed to the gravity and inertia of the power unit, making good speed regulation possible.

Section *Y* is a plan of the collapsible piston and shows the relative positions of *B* and *C*. *L* shows position of adjusting valve. *M* in section *X* shows the possible position of *B* and *C* with a rapid movement of the piston. In the new type governors this member is replaced by a mechanical device, the great advantage of which is that it is purely mechanical; therefore more reliable than any hydraulic arrangement.

In conclusion will say that all good engineers who have given the subject careful thought agree that the ideal governor should be simple and easily managed.

It should be carefully and compactly designed.

It should have a powerful and exceedingly sensitive control governor.

It should embody a powerful and reliable gate-moving element, whose every movement is gradual or of a differential character.

It should be limited in its velocity of gate movement to the hydraulic and mechanical conditions of the power unit.

It should have enough temporary and differential drop to make it adjustable to the present-day power unit conditions.

It should have an adjustable permanent drop, so that this factor can be reduced to a minimum in the plant governed.

It should be provided with means for temporarily changing the speed for synchronizing purposes, and this feature should be controlled from the operating board of the modern power plant.

Erratum.

In the drawing "adjustable centers for turning crank pins," at page 681, the dimension 14 inches should read 4 inches.

If the operator of the De Forest wireless telegraph station at Galveston, Tex., knew as much before the San Francisco earthquake as he knows now, that city might have had a warning of the catastrophe which was to overtake it. On Tuesday night, before the earthquake, the sputtering and sparks of electricity in the station aroused the operator, who thought it was some ship or other wireless station calling his station, and he accordingly made answer, signalling repeatedly, but failing to get any intelligent response. The sputtering and sparks continued at intervals, and the wires acted as if they were possessed. Careful examination of the apparatus failed to disclose any reason for its erratic behavior, though he remained on duty all night. He signalled Denver and East St. Louis, 800 miles away, but they had not called, and shortly after midnight he was compelled to abandon using the keys, as the instruments became so charged with electricity. After hearing of the earthquake on Wednesday morning, the operator realized the cause of the magnetic disturbances about his instruments, and remaining on duty he was able to record the subsequent quakes felt on the California coast, it being found afterward that his instruments anticipated the quakes by several hours.

The common opinion that slightly alkaline waters have no effect upon iron is controverted by experiments by C. H. Cribb and F. W. F. Arnaud, who suspended polished strips of steel or iron in very dilute solutions of sodium hydrate, calcium hydrate and sodium carbonate, for 24 hours, and then determined the weight of the oxide in suspension and in solution, the experiment being made both at the temperature of the atmosphere and at the boiling point of water. The results which are given in the table before the Society of Public Analysts show that the maximum effect was attained with solutions containing 1 to 1.5 cubic centimeters of decinormal hydrate solution per 100 cubic centimeters of water.

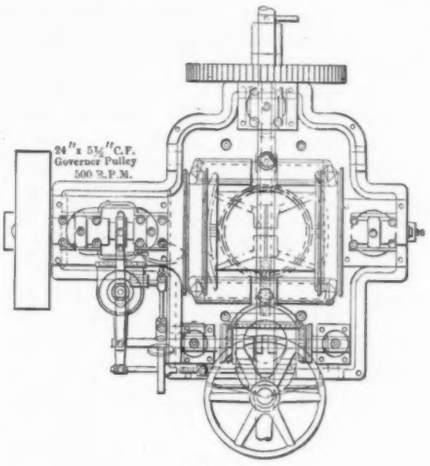


FIG. 5

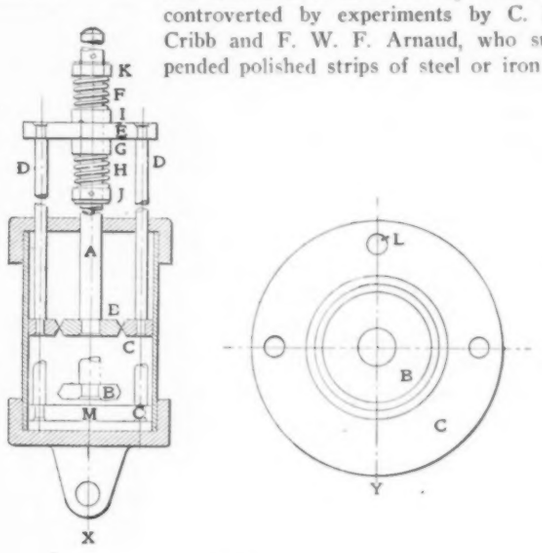


FIG. 8
Apparatus for obtaining Dash-Pot Effects

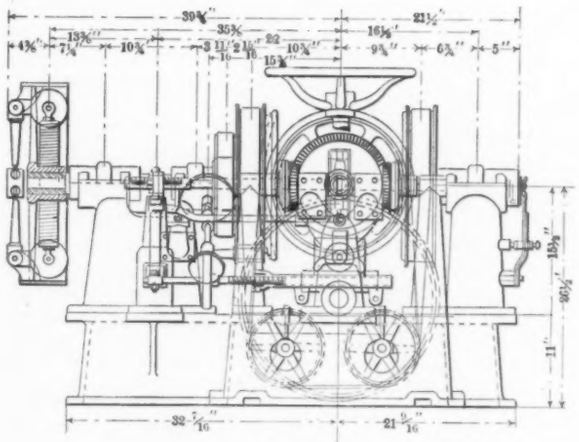


FIG. 6

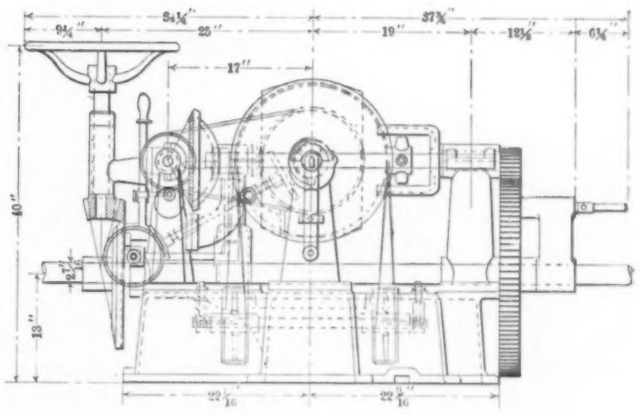


FIG. 7

GOVERNOR FOR THE POWER HOUSE OF THE SANITARY DISTRICT OF CHICAGO.

It should be built as accurately as present-day methods will permit.

All of its important bearings should be self-oiling.

It should be noiseless in all of its actions.

It should require a minimum amount of power for the performance of its duties, and when it is not laboring but is waiting for inspiration, the energy required should be reduced to a mere driving of empty belts. The ideal governor should be mechanical in its every detail.

Some Diverse Metric Experience.

Some of our readers who have followed our articles upon the metric subject will recall the fact that we have repeatedly invited contributions from those who have had experience with both systems of measurement (metric and English) in machine construction. We have limited our contributed articles to those written by such men because we have considered that there is already plenty of literature in the nature of general discussion, of the relative merits of the two systems, and that our readers would not be benefited by nor particularly interested in discussions of the subject by those who have had no experience qualifying them to draw comparisons.

Not only have we invited such contributions by publication of our general invitations, but we have in many instances written letters to men whom we happened to know had had the specified experience. In many instances we have not known in advance whether these men favored the metric or the English system, but in writing to them have usually said that whatever their opinions might be as to the comparative merits or demerits of the two systems, we would be glad to publish them.

Our idea in this has been that builders of machinery and mechanics do not wish to be convinced one way or the other by partizan articles written by men who merely happen to have espoused the one side or the other of the controversy, but that they wish to know and are entitled to know the facts so far as possible as to the use of the metric system in machine construction. Knowing the facts they can be trusted to draw their own conclusions.

It so happens that nearly all of the articles we have succeeded in drawing out have been from men who, as a result of experience with both systems, favor the metric. In some cases where we had been told of men having had specified experience, and who were believed to be opposed to the metric system, we upon writing to them either received no reply or a reply favoring instead of opposing the metric system.

The practical unanimity of the letters received has led to some suspicion that we were unfair to the other side, though the record shows that we have not been. However that may be, we have recently made some special effort to get communications from men having had the specified experience and who were known to be opposed to the metric system. The letters of Mr. Peache, the new works manager of Willans & Robinson, published at page 686 (last week) is a case in point. Some time ago we asked Professor Sweet to give us the result of his experience, which he promptly did, and we have been holding his letter, expecting to present with it the letter of another prominent engineer whom we know to have had the specified experience and to be opposed to the metric system. He promised to write for us, but the promised letter does not come, and so we present Professor Sweet's letter as follows:

PROFESSOR SWEET.

"I am in receipt of yours asking me to contribute an account of my experience with the metric system, and in reply I have to say that I can see no reason for any discussion on the subject, except as it relates to its adoption by our people, and no use in our considering the matter, except as it relates to the use of the linear measure in mechanical operations. As I was raised as a farmer boy, and spent the first ten years of my active life as a carpenter, joiner, builder and architect, I cannot avoid the consideration of the subject as it relates to those industries, and then as I became a pattern-maker, draftsman, a designer of machinery and a builder of things in the machinery line, which is what at present most nearly interests us, I cannot avoid a consideration of what would be the result, should the attempt be made to educate our people up to its adoption.

"If we are compelled to use it we can learn it easily enough, but the trouble would be the incomputable cost and endless confusion that must inevitably occur, and for an indefinite period. This is not given as an opinion but the experience of every country, where the change has been and is being tried, proves it.

"While I was a draftsman at the works of the Patent Nut and Bolt Company, in England, during four years of the sixties, we had a good deal of work for France and her colonies and used the metric system from necessity for that work. I learned to use the metric system in the drafting room and, like about all draftsmen, became fascinated with it. Nothing was done with it in the shop because the workmen could do nothing with it, and everything had to be made from models; no measurements were made or used, and no bother came from the screw threads, as all were the Whitworth or the English.

"While exhibiting at three different Paris exhibitions we ran up against it, mixed with English; Mr. Steinlen, who undertook the building of the Straight Line engine for Europe, made a complete set of new designs by metric system, and it was curious to observe that everything was as near the multiple and sub-divisions of the English inch as the millimeter would permit, though the sizes and drawings were not copies of our own.

"In the building of the Solvay Process works here in Syracuse, the plans for which were made in Belgium by the metric rule, we came up against the proposition hard. It was soon found absolutely impractical for the Solvay Company, who were building the buildings, ordering work from dozens of manufacturers, and doing much work themselves, to get along at all with the metric linear measures and all the plans had to be changed to the nearest convenient English dimensions, and we are yet (twenty-five years later) making standard pipe, not 2500 millimeters long, but 8 feet 2⅜ inches; and not 100 or 150 or 200 millimeters, but 3 15/16, 5⅞ and 7⅞ inches diameter, called 4-, 6- and 8-inch pipe.

"None of these are right, and while they answer for pipe they would not do at all for line shafts. This brings out another feature about transposing the metric measure into English.

"Another company, the Semet-Solvay Company, conducted under a different head from the parent company, found that 8 feet 2 7/16 inches was nearer 2½ meters (No! I should say 2500 millimeters) than 8 feet 2⅜ inches and adopted that length, and so we have two standards of pipe lengths which we are compelled to supply. This does not involve extra patterns but the finished lengths pipe have to be kept separate. This is but one of the dozens of things that are English compromises which have had to be made, and instead of reducing figures, about everything is multiplied twofold.

"For the reason that the Solvay Process Company in this country is one of a dozen branches in various parts of the world, whose outputs are constantly being compared one with the other, they adhere naturally to the metric weights, which cost nothing extra and are indisputably easily figured. But this shows that even in this industry, where the entire product and that from which it is made, goes by weight, and the work of making the product almost wholly mechanical, there is no value in the inter-relation tween the two.

"While a metric ton is the weight of a cubic meter of distilled water, and while so much has been said and claimed by the advocates and admirers of the metric system as to its scientific basis, which means the inter-relation of lineal measures and weights of the system, it may be worth while to see where the use of this feature leads.

"Someone favoring the system, and I think it was the Assistant Secretary of Agriculture, points out the advantage of it in this, that one can tell by measuring with the metric rule whether the measures for grain and liquids are correct. Think of a farmer measuring a round tapering half-bushel (No, a 50-kilo grain measure) and computing its cubical capacity, to see if it contains the proper number of cubic centimeters, or the housewife computing the contents of a tapering tin cup to see if it holds the required demi-liter of milk. Where the area of a circle is involved the metric system has no special advantage, and as all measures are round, one way or another, the claim for the merit of the inter-relation is about as weak as the claim of its scientific origin.

"The objections to the attempt to introduce the lineal measure in this country are numerous, assuming it to be possible in the bulk of our mechanical industries. First, in many respects it is not as good as our own. Take carpenter and joiner work, it is a physical impossibility to make a tool on the metric system divided by metric units comparable in convenience to the carpenters' steel square. It is also a physical impossibility to make a complete metric rule with the conveniences of the 2-foot rule to make work by, that is, for those who make things in the shop. I do not include the tool room and drafting room, but shop work.

"For making definite measurements of things already made, the common folding metric rule is certainly better than a tow-string, but not much; and as for definite measures, let him who likes it try to set off 618 millimeters and see how near he gets it. Watch him do it! He finds his 600, then 10, then 15 and counts off his 16, 17 and 18. There may be those who can stick their knife down at 618 as a pattern-maker would at 23 5/8 inches, but I haven't seen one that could do it.

"The change cannot be made in our land measure nor in the buildings that go on it; the builders know too much to change, so the foot and inch we will always have with us. To introduce the meter in any constructive work means two incommensurate systems, first, last and always.

"The civil engineers in their field work use the foot divided into hundredths, but it is the same foot we use, and in their cuts, fills and embankments they use the cubic yard, and their dams, water works and bridges are built in feet and inches.

"Many things, aside from the inconvenience of the tools and ordering the stock, can as well be made by our measure as the other; bridges and furniture for instance. Furniture in particular has no past and no future, when it is made that is the end of it, or should repairs be needed the measurements are of no moment.

"Perhaps the greatest objection to the attempt at the adoption of the system in this country in the machinery line is the cost, the mixing of the two systems for two or three generations under the most favorable circumstances, the endless inconvenience, and the practical impossibility of getting the common workman to use it without an infinite number of mistakes. For a number of years the works with which I am connected has been doing work for Belgium, according to metric measure. We provided ourselves with a B. & S. standard meter and tried to have the men work from the drawings and by that, but it was just no use, and so we had standard gages made by the toolmaker for every measurement for the workmen to use, and this in a way explains why the Sellers people in their injector work and Willans & Robinson get along. Their product is all made by special tools and jigs, though Willans & Robinson's was mixed in the same business with English work, and it is pretty authoritatively stated that they swear *at* and not by the metric system today.

"In making the gages for the Belgian work both the toolmaker and foreman made a mistake of two or three millimeters which was carried into some $500 worth of apparatus before it was discovered, and cost some cable messages to straighten out the trouble.

"There are of course mechanical industries where possibly it could, if all work was done by the metric system, be an advantage. In gearing there is a good deal of figuring and it is possible if all the sizes were originally based on the metric unit and the tables as completely perfected as in our own, it might contribute to the saving of figures, but to establish a shop system on that basis and have endless orders come in in inches, would probably cause more figuring to translate the sizes than would be saved by the change. So much of this translation is still being done in the metric-using countries, that rules with metric on one side and English on the other in places (Spain for instance) are more common than simple metric rules. Such a rule would not, I suppose, translate accurately enough for gear work, certainly not accurately enough to have work made in one place by English measurement fit French work made in another.

"The man who works in the office, does the figuring and writes the specifications sees the advantage it will be to him, and the friends of the system who write for the papers are largely of that class; the men who do the work and have had anything to do with it know the difficulties, laugh and swear and say to themselves: "Never mind, nothing will come of it any more now than there has after sixty years trial," hence the AMERICAN MACHINIST has not been burdened with their song. The few who *claim* to be at the top and think they do all the thinking (but don't) want the many who do the work to come their way.

"The scientists who like the metric system and think we ought to adopt it because of its convenience do not understand why we, who make things, do not like it, and to those I beg to suggest the following: Have some friend fold two strips of paper, one into eight folds and one into ten, then take them himself, straighten one out and he will find he can straighten one out as well as the other. That is the scientist's end of the business. Then let him take two other strips of paper and fold one into eight folds and the other into ten and he will find the workman's end of it. This may be an exaggerated example, but carrying a thing to the extreme is the best way to get a realizing sense of a mechanical proposition.

"Those who advocate the adoption of the system here claim that we can easily make the change because they have in Germany. The change has only partially been made in Germany and they have been thirty years about it. Their class of buildings are very different from ours and the class of carpentry work done here is scarcely known there. Besides, the English measure or the German inch and foot are yet used to more or less extent in building, and the English still holds its place in other things. Besides, there was a reason for the Germans adopting the metric system. Where the separate States all having their own standard varying in one way or another if ever they were to adopt one common standard, which in their case was a desirable thing, there was no way possible except to adopt something different from either; the metric had that merit, it had the indorsement of the scientists as it has here, and was adopted, but failed to meet the approval of workmen and common people as it has wherever attempted. But whatever its merits, and were the advantages of a universal system all that its advocates claim, it would have no merit as applied to buildings, as no one is buying or exporting buildings.

"The advocates claim the adoption of the system would save a year's schooling. In the eight years' course of the grade and high school in this city (Syracuse) there are laid down 125 exercises; 16 of these are in mathematics, 2½ in English weights and common fractions, 3½ in decimal fractions and the metric system and less than one year in mathematics altogether; so if the claims of the advocates are correct, we have only to adopt the metric system and do away with studying mathematics entirely.

"So far as the schooling is concerned, I believe the best thing to do with the metric system is to eliminate it from our school books altogether. It takes a lot of the scholar's time, is a vexatious thing for the teacher, it is something that cannot be remembered except by those who use it, and the 5 per cent. of the public school children who go to the technical schools and colleges where it is used, can learn it as fast as its use comes up; while to the 95 per cent. who worry over it in the grade schools it is wasted time.

"The advocates of the metric system claim there are some 36 countries which have adopted the metric system, and but three countries that have not, but omit to mention that there are about 150 million more people in the three countries than in the 36; omit to mention that the metric system is far from universal and that there is immensely more weighing and measuring done in England and America than in other parts of the world. It is

true that the metric system is used to a considerable extent in this country, but it is not in the machinery line, which is what interests us, and on the other hand, the English system is used largely in the machinery industries in the metric-using countries.

"Asking the M. M. of the Mexican Central Road how he got along with the metric and English mixed, his reply was: 'We don't get along with it as we use nothing but English!'

"A very expensive measuring machine six or seven feet long, put in by a prominent firm in Belgium, is graduated for both systems and one can easily contract for work in either system in Belgium and Sweden."

FROM A MICROMETER MANUFACTURER.

Some time since we received a communication from J. T. Slocomb, the micrometer-caliper manufacturer, of Providence, which seemed to us to indicate that he was opposed to the metric system. Finding he had had experience with it we invited him to contribute his testimony. His letter is as follows:

"Complying with Mr. Miller's request to give my experience with the metric measure; saying that he wants the experience of men who are equally familiar with both measures, I will contribute what little I can.

"It will, I think, be hard to find a man who is equally familiar with both measures.* I have used the English measures about 30 years and the metric just enough to get out a line of metric micrometers, and some small jobs to foreign specifications. When we start to consider improvements, it is well first to consider if we are getting the best service from what we already have. The English measure we are using in the shop has come down to us from the blacksmiths, millwrights and carpenters, who first started to build machines, and so it is no wonder that the smallest unit, that is often considered as an actual measurement, is 1/16 inch. We need something much finer, and it is a question if it should be 1/1000 inch or millimeters and 1/100 divisions of same. Most, who have had experience with small sizes, will admit that 21/32 or 57/64 are clumsy ways of expressing and understanding sizes. We can't always conform to even 16ths, and if we give this odd size in thousandths, say 0.8906 the equivalent of 57/64, with the present education in the shop, it is apt to be understood that greater precision is required; although there are no real reasons for this, as the degree of refinement should be expressed in other ways. The millimeter as a unit, is better than the 1/16 inch, because it is smaller.

"Most of the discussions I have heard in regard to metric measure are about its different denominations, whether it is best to divide always by 10 or by 3, 12, 4, 8, 16, 32, etc. This may cut some figure in large work, but as far as my experience goes, I forget all about everything but millimeters. We make micrometers to 300 mm., without marks of other denominations, and have sold many in France and Germany without ever having a complaint. I have seen measurements given to 1200 mm., and will ask how large it is customary to express measurements in millimeters only? For light machine and tool work, measurements in millimeters and 1/100 divisions of same, will compare favorably with inches and 1/1000 divisions. Used this way, I believe it is only a question of practice. When a man uses the metric most, he will lose familiarity with the English and is ready to insist that the metric is best, or *vice versa*. For machine-shop purposes, if people will drop the carpenters' and millwrights' system of using the English measure, and adopt inches and decimal parts of the same, using micrometer calipers for their gaging, instead of solid gages to 16ths measurements, they will make about the best improvement that is possible to make in modern shops at this time."

FROM HANS RENOLD.

Hans Renolds, the transmission-chain manufacturer, of Manchester, was born and raised in Switzerland where they use the metric system and he worked for a time in France as a draftsman. He has for years been manufacturing in England to the English system.

We asked him for an expression of opinion based upon his experience. Part of his letter relates to other things, that which relates to the metric system is as follows:

"I have never cared to enter into public discussion about the merits of this subject. It seems to me so simple and the only logical system, which the French have worked out over a hundred years ago, and which would have been a great benefit if the world all over had adopted it. In our works we never use anything but decimals, though based upon the English inch which unfortunately has no relation whatever to weight and volume measures. In 1880-1-2-3 we worked with the meter system, but I met with so much difficulty and obstruction, and was then such a small island in a big sea of ignorance, that I had to yield and return to the measures and weights of the country. How it is possible for any engineer to work with 8ths, 16ths and 32nds surpasses my understanding. The demands of my business are such that I could not do it even if I tried hard. I know there are some people who say an inch is a workable or handy length and that a centimeter is not, or that an eighth of an inch is better than a millimeter, but I cannot support this argument. Of course a millimeter is not ⅛ inch and an inch is not a centimeter, but one soon gets accustomed to express one's dimensions with a slightly larger figure when millimeters are used; in fact, as it is now, all dimensions under one inch we express in thousandths. I personally detest this English measure, the more because in Switzerland, where I received my education, the metric system is used throughout, and the step I had to take was a retrograde movement, entailing a great deal of inconvenience, extra labor and cost.

"To sum up, my attitude on this question is this: Experience has taught me that talking and writing is of little use, but if one believes in a system as I do, to go ahead and adopt it. If it is good, as there can be not the slightest doubt, others soon find it out and will follow. I am doing a very large trade with France, Germany, Switzerland, Italy, Belgium, etc., where millimeters are used, and so have continually to work in two systems. In the course of a year or two, when I have overcome the great pressure of work which has been lying upon me during these last few years, caused by new installations and enlargements, I shall then take a plunge and have the metric measures of length, weight and volume rigorously introduced *in toto*."

BOTH SYSTEMS ON THE SAME PIECE.

Some time ago a friend of ours brought in a copy of *The American Jeweler*, in which was an article entitled "The Balance Staff of the New England Watch." In this article were reproductions of a number of drawings of the balance staff, all with figures giving sizes and each drawing having the legend

Diameters and slot.....Metric measure
Lengths .....English "

This seemed a very curious mixture of the two systems, and our friend remarked that one who favored either system could find support for his views from the same drawing or from the practice of the same establishment.

Quite a while ago the superintendent of this watch factory had been mentioned to us by George Bond as one having had experience with the metric system, and being opposed to it. We wrote him for an expression of his views for publication, but were not favored with a reply. So in this case we wrote to the company as follows:

"We note in a recent issue of *The American Jeweler* an article based on your practice in the making of balance staffs, and notice that while the lengths of these staffs are figured in decimal parts of an inch, the diameters are figured in decimal parts of a millimeter.

"While we may be able to make a guess as to the reason for this, we would like, if practicable, to have your statement of the reason, as it is a thing that is of considerable interest to constructors of machinery everywhere, particularly here and in Great Britain, where this subject of a change to metric measurements, and particularly of the practicability of doing

*Mr. Slocum is here slightly mistaken. We did not say "equally familiar," but that we wanted the testimony of men having had experience with both systems in machine construction.—Ed.

work in the same shop to both the English and the metric standards, is being discussed, and is likely to be a matter of considerable interest.

"May we ask you, therefore, to give us your shop experience, or rather your impressions of the practicability of doing this work in the manner indicated; that is to say, whether the two systems of measurement used in this way, side by side, and on the same piece, result in any great inconvenience or added expense in construction?"

Their reply, written by A. O. Jennings, treasurer, is as follows:

"Yours of the 30th ult. received, making inquiry as to our use of the metric and English standards of measurement.

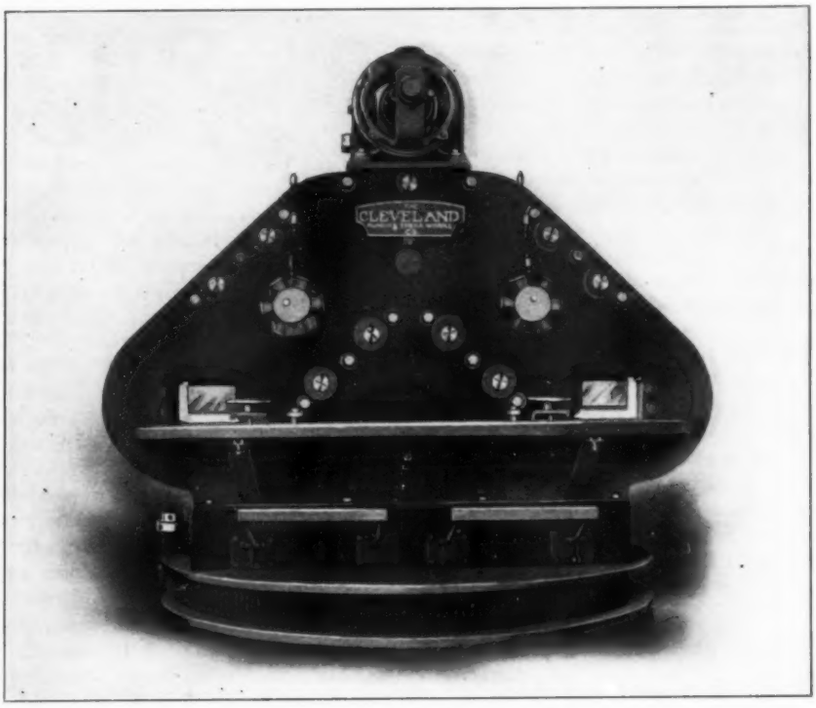
"We find no objections to the use of both, or extra expense. It was brought about in our case by necessity. We could not secure the proper gages for various work only in the metric scale, and so we adopted it, and use them both."

From the mechanical standpoint this is not very satisfactory, for it so evidently leaves so much unsaid that would be very interesting, but it is the best we can do. We happen to know that the late Ambrose Webster, of Waltham, who originally designed, built and equipped this shop, believed in the metric system, and we understand that it was originally laid out to manufacture on that system. Perhaps there is in that fact some explanation of the curious phenomenon of metric measurements being used for diameters and English measurements for lengths of the same pieces.

The highest melting point of any metal is that of osmium, about 4700 deg. F.

An Odd Motor Application.

The accompanying illustration shows an interesting application of the electric motor drive. It is an end view of a big shear operated by the motor seen at the top. The machine is a No. 7 Angle Shear built by the Cleveland Punch and Shear Company and used for very heavy work, cutting off 7x7x1-inch angle bars on the angle without trouble. For driving this powerful machine a comparatively small 20-h.p. type CQ motor (230-volt, compound wound), built by the General Electric Company, is employed. From the insignificance of its size in comparison with the bulk of the shear, and also from its position at the top of the machine, the motor may be considered as typifying the part played by electricity as a motive power in modern industry. It illustrates clearly the compactness and adaptability of the electric motor for driving machine tools.



AN ODD MOTOR APPLICATION.

Growth of the Engineering Departments of Purdue University—The Annual Commencement.

There have been regularly enrolled during the past year in the three schools of engineering of Purdue University 1236 students and the prospect is that for a time at least, the number will steadily increase each year. In anticipation of such a result, and to better provide for those already enrolled, the facilities for engineering work are now being greatly increased.

A new building to be devoted entirely to the school of civil engineering is approaching completion and will be furnished ready for occupancy by the beginning of the next school year. An addition to the electrical laboratory now under construction will supply a new lecture room and extensive additions to the laboratory floor space of this department. The laboratory is to be served by a traveling crane and is to receive additions of other heavy machinery. The test car "Louisiana," which was brought into existence by the American Street and Interurban Railway Association, has been deposited with the university and is to have a place in this laboratory.

The mechanical engineering laboratory is also receiving new equipment. This consists of several additional machines and a large amount of small apparatus for testing the strength of materials. The steam-engine laboratory is receiving a large order covering indicators, gages and miscellaneous small apparatus, an elaborate collection of water meters, an Ingersoll-Rand No. 10 Imperial steam-driven compound duplex air compressor, a 50 horse-power Fairbanks-Morse gas producer and gas engine, several smaller gas engines, one Power Specialty Company's superheater, one Allis-Chalmers direct-connected Corliss engine and centrifugal pump, one DeLaval direct-connected steam turbine with direct-connected centrifugal pump, and one 100 horse-power compound marine engine, with all auxiliary apparatus. This equipment will be available by September 1.

The annual commencement exercises were held in Fowler Hall on June 6, an address being delivered by Prof. Albion W. Small, of the University of Chicago.

Proposed Government Commission to Consider Weights and Measures.

A bill has been introduced in the House by Representative Lilley, of Pennsylvania, for the establishment of a commission on weights and measures, to be composed of not less than nine nor more than fifteen commissioners to be appointed by the President and ratified by the Senate, and to be elected in such a manner that the various important professions and industries would be represented, and particularly the scientific, industrial, agricultural, commercial, mechanical and maritime.

It would be the duty of the commission to investigate and report to Congress upon the subject of measures of weight, length and volume at present in use in foreign countries, and to suggest any expedient and feasible improvements which may be made in our own systems of weights and measures. Among the questions that it is suggested the proposed commission would have to deal with would be: First, the question of retaining or modifying all of our present methods and standards of weights and measurements; second, in the event of the present units should be retained, then the

question of their simplification for the purpose of computation, both as to the sub-divisions and multiples of such units; and, thirdly, if the present systems are to be discarded, then the advisability of substituting for the same the metric system.

It is proposed that the commissioners should receive $3,000 each per annum during the time of their service, which should continue until their work is completed unless removed from office for inefficiency, neglect of duty, or malfeasance in office. The headquarters would be in Washington, and public hearings would be held if deemed necessary. It is also provided that sub-committees could be appointed for the purpose of making investigations in different parts of the country. Reports would be submitted to Congress from time to time, and the work would be expected to proceed with as much celerity as possible.

The bill also provides for a conference between the Governments of Great Britain and the United States for the purpose of securing unity of standards of length, weight and volume measurements used by both countries, the conference to be called by the President, at a time and place to be selected by the Executives of the two governments and five of the commissioners would be appointed to attend such joint conference on behalf of the United States, for which they would receive an additional $2,000 per annum.

How to Sell Machinery.

The initial number of the *Selling Magazine* contains an article which, whether or not it is true as a reflection of conditions or as a prophecy, will be read with interest by those who are in anyway connected with the machine-tool business. The author, who signs himself, "Scrutator," is described by the editor as a "successful machine-tool salesman best hated of Dey, Liberty and Cortlandt streets." There are other claimants to this distinction and the title may be disputed, but, however that may be, the article follows:

The editor requested me to make a few remarks about "How to Sell Machinery."

Some years ago, when the subject of resuming specie payments was being discussed, Horace Greeley said, "The way to resume is to resume."

Not long ago another distinguished gentleman said, "The way to convict is to convict."

And by the same token I say, "The way to sell machinery is to sell it."

Neither Horace nor Alton said anything about getting someone to do your resuming or your convicting for you on a 10 per cent. or 12½ per cent. commission.

In other words, "If you want a thing done, and done right, do it yourself."

THE MAKER SHOULD DO HIS OWN SELLING.

Why should a maker of machinery pay a dealer 10 per cent. to sell it for him, when he can sell it for 10 per cent. himself and keep the business in his own hands?

A good many machinery manufacturers have recently increased the discount to dealers from 10 per cent. to 12½ per cent. because the dealers, in solemn convention assembled, said they could no longer afford to do business on 10 per cent.

And yet almost every mother's son of 'em cuts prices!

And one of the chiefest among them arose and admitted that the manufacturer never was known to get rich.

He didn't say whether any dealers ever get rich: it wasn't necessary.*

SAME THING, SAME QUALITY, SAME PRICE TO ALL.

There is one—and one only—simple and sensible, and democratic way to sell machinery, or anything else for that matter; no artificial schemes for "protection" of this, that, or the other party; everybody on the same basis, and it will come sometime: *The same price to everybody for the same quantity of the same article.*

There you are!

"Oh, but I am a dealer! I have to pay rent! I am in the business! I have got to sell again and must live!"

Admitting (which I don't) that you must live; if I am a maker of machinery and you a dealer, I will sell you a *stock* of machines at a lower price than *one* machine, and you can peddle them out at a profit, same as you would twist drills, or belt laces, or cigars, or ice cream soda water; and I will sell any other man, whether he is a dealer or not, the same number of the same machines at the same price.

A PROPHECY.

I know what everybody (almost) will say, soon as they read this letter, but I will have to stand it and am willing to go on record that machinery will be sold on practically this plan inside of ten years.

When I say a maker should do his own selling I use the word in the same sense as the word "making." The maker doesn't necessarily go on the road personally to sell his own product, any more than he puts on overalls and runs a lathe to make his own product.

The hardest metal, with the exception of steel, is tantalum, which will scratch glass and quartz. This metal has a specific gravity of 12.79, being heavier than lead; it is white and has a crystalline fracture. By the use of the electric furnace Moissan has succeeded in producing metallic tantalum in the reguline condition.

*Manufacturers do sometimes get rich, but only when they retain control of the commercial end of their business, though this, of course, does not mean that they must have nothing to do with dealers.—Ed. A. M.

Letters to the Editor.

Breaking Up Masses of Iron.

The description at page 235 of the removal of a "salamander" from a large blast furnace, recalls to mind a somewhat similar series of operations carried out for breaking up a number of big foundry ladle "cold snaps," that had occurred in a very large foundry run by friends of mine.

These misfortunes were due to a variety of causes, such as a badly working set of cupolas, inexperience of workmen connected with them, frozen tap holes found impossible to clear, etc.; the result being that the foundry had on its hands a number of solid lumps of iron some 7 feet high and 4 to 5 feet in diameter, weighing anywhere from 18 to 25 tons, and if I remember rightly, the largest was considerably heavier. It was impossible to pour out these while in the ladle, as the method was to have a big reservoir ladle, standing, at proper length for running, on the floor, and fill up this from ladles brought from the cupolas by a crane. Once full and the iron not supplied quickly enough, allowing the metal to become too cool, nothing could be done with them. Holes were cut higher up, when the tap-holes were found to be frozen, but all to no purpose, and the immense lumps mentioned resulted. This was a sad and costly experience for my friends, but after some alterations were made to their cupolas, they had their iron hot enough and in such quantity that they had no more such mishaps.

These big pieces were, with much difficulty, removed from the foundry, and stood around in the yard like sentinels for some months. One or two attempts were made to dynamite them, but this was abandoned for several very cogent reasons. One day when on a visit to this foundry I suggested to my friends that they might be disposed of in a manner which struck me as feasible, and which, at any rate, would not cost much to try. After a good deal of banter, they said they would try my proposal, and this was done as follows: The firm had a very strong tripod some 15 or 16 meters high, fitted with a steam winch for raising a 2-ton tup for smashing up pieces of very heavy scrap. The cast-iron blocks to be operated on were taken in hand one at a time, the biggest being first tried. It was placed, firmly bedded, on end and vertical; in its top were bored a series of holes 1¼ or 1½ inches in diameter by 16 or 18 inches deep—one being in the center. To a push fit to this hole was turned a piece of tough tool steel, the head of which was all but flat, and with a center left in. A very fine groove, a mere scratch, was made on one side, and the center hole in the block to be operated on was filled with water within 4 inches or so of the top. The plug was tallowed and forced

home to the surface of the water, the fine groove letting the air escape as this was done. The underside of the tup was then carefully leveled so that in falling it would give a thoroughly vertical and fair blow. A fine hole was made in the center of the underside of the tup, which was raised to its full hight, about 12 meters from the top of the casting to the underside of the tup. From the small hole in its underside a plumb-bob was let down, and the tripod was adjusted till the center of the plumb-bob came exactly over the center of the plug inserted in the center hole of the casting, the plug projecting some 4 or 5 inches. A special releasing snap had been made to hold and release the tup, and held by a piece of thin marline. Very great care and much trouble had been taken to assure the accuracy of setting the tup central and a non-jerking release of it. A man was sent aloft and, after everyone had cleared out, he severed the marline holding the releasing snap, with a razor, probably an unnecessary refinement, considering the weight of the tup. The effect was, that the massive block of iron below split in two from top to bottom along the line of holes that had been bored in top.

Afterward this method was adopted for breaking up the whole of these blocks, and it was found that it was by no means necessary to use very accurately fitting plugs, as the immense weight and the suddenness of the blow gave no time for the water to escape around the plug. It worked just like dynamite, and gave the characteristic cone of compression similar to that shown in one of your engravings of the salamander as resulting from dynamite.

Shortly afterward this firm took a big contract to break up a very large number of rolling-mill rolls up to 3 feet diameter, and made a good thing of it. Anyone adopting this idea should take great precautions to have the whole affair inclosed and guarded by thick planking, as chunks of iron fly off in a very erratic and dangerous manner, if the tup is not fairly central, or if the pieces operated on are irregular in shape.

On the particular job mentioned the laborer who had contracted for breaking up a lot of castings by this method, had become careless, familiarity breeding contempt. Result, a lump of iron found its way right through the muscles of the thick part of his thigh. He had found it eventually too much trouble to go in out of the rain, so to speak. When he was well, and at his job again, he took shelter.

This way of dealing with refractory lumps of iron may not be new, but I have seen no mention of its being in use up to the time I suggested it. If it proves as useful to others as it did to my friends I shall be glad to hear of it. R.

Charkov, S. Russia.

Designing a Boring Mill—Being Taken Seriously.

My sympathies are all with Entropy, for I too have had difficulty in getting people to take me seriously when at my gravest, and have been in earnest when "the reverse was the opposite" as the old Scotch magistrate said.

When I read Entropy's article on designing a boring mill, I took it in all seriousness as it looked so much like the way a friend of mine across the water has done some very successful designing, a method which I have tried in a small way and found good.

Even if Entropy's method of designing be *not* of a high order, his humor *is*, and I for one hope that he will tell us in the same vein how to design all the other tools found in our shops and when he gets through these let him start on those (designed from books) found in our scrap heaps.

I will not offer any suggestions on designing boring mills, but I am an authority on being taken seriously when I don't mean it, and the reverse when I do.

Some years ago an old man with long straggling white locks and a bristling white "shiver de freeze" mustache drifted into the shop from the backwoods of Pennsylvania.

He had some rough diagrams which he called *"hand* sketches" (accent on "hand" lest I suspect him of having made them with his feet when drunk) of a thing he hadn't christened yet, for telling how far a ship sailed in a given time. It was a crude taffrail log, similar to those one sees in the marine stores along the water front in any maritime city. My surprise that he had never seen any of these led me to question him; it was then I discovered that this was his first visit to a seaport town, and as yet he had never seen a ship. After a glance at the "hand" sketches I said, "If you will take a walk along Delaware avenue, South or Bainbridge streets you will see about three of these things in every pawnbroker's or marine store."

This is where he did not take me seriously.

"Yes?" he inquired, holding up three skinny fingers, "three in every broker's an' two in every notion store I suppose (sarcastic). Why man, that's *new!* I've worked in secret on them *hand* sketches for nigh onto twenty year, and that there speed finder thing is *new,* will yer make it?"

Here was a genius, he had worked, for "nigh onto twenty year" on *"hand"* sketches which I could produce with the aid of a touch of delirium tremens in twenty minutes. I was disgusted with myself, I who when working in the shop had rather fancied myself at "soldiering" when it was necessary to give a cantankerous foreman an object lesson by spinning a two-hour job out to ten.

"Yes," I would make it, as he positively refused to have his folly pointed out to him. So the thing was made, the pitch of one blade measured as close as we could do it, and the others corrected from it.

During the time the work was in progress the old man would take trips down to the river to see the ships. They were all *ships* to him, from the big five-masted full-rigged clipper down to the little oyster sloops. Many and wonderful were the discoveries he made. One day he came into the shop all out of breath and announced without any apology: "I have found a bigger liar than you, Dixie; this feller says it's so deep in some places out to sea that ships like his'n can sink clear to the tops of their masts."

But to get back to my yarn. The log was finished. The old man had gained sufficient confidence in me to ask my advice about testing it.

"Hire a tug," said I, "and run a distance that is known, say from so and so to so and so, just at the slack of the tide, so that you won't have to make allowance for it."

It then developed that he was so afraid of the water that he had not ventured on one of the "ships" he had visited even while they were tied to the wharf, but had talked to the men who go down to the sea in ships from a coign of safety on the pier. I suggested his letting someone else try it, but that would not do, as he was afraid they would "give it a black eye."

Here was a problem. A man with a nautical instrument afraid to try it himself, or to let anyone else try it on shipboard. No solution suggested itself to me, so I said, "Oh, go to grass!"

This happened about noon; he paid his bill and took his log with him.

And this is where he took me in earnest.

Along about two in the afternoon I went out to see how some outside work was progressing. I turned north on Seventh street and started across Franklin square. When I got to the middle of it I noticed there was something more than usual interesting the children of the gutter who gather here in the long summer days to enjoy the grass and trees. "I'll hold 'er up fer ye, mister!" "Why don't yer put a tail on 'er?" "She won't fly 'less yer let out more string!" He of the grizzled locks was cavorting like a wild thing through the tall grass dragging his taffrail log behind him, his long white hair streaming in the wind, the sweat pouring off him, but a look of beatific happiness suffused his wrinkled old face every time the little bell registered another quarter nautical mile. A gang of urchins were following and surrounding him. They mistook the log for some kind of a kite; hence the suggestions about "more string," "a tail," etc.

I never saw the old man again, but if his face portrayed his emotions, the pleasure he had in dragging that log and hearing the little tell-tale bell announce the quarter miles was worth all he paid me for the job. DIXIE.

Odds and Ends From a Country Shop —Cutting a Face Cam in the Lathe.

I still remember quite vividly the elation which filled me when I was "promoted" to a lathe in the old B—— shop where I served my time. The usual preliminary months at chipping and drilling castings had whetted my appetite for the moment when I should be able to grind and set a tool properly and then, with folded arms lean nonchalantly back against the tailstock and watch the shining ribbons curl and twist away, sometimes a stray one worming its way over to the drill press where some other poor devil of a cub would be learning how not to bark his knuckles more than six times a day.

That was the way F—— did it. F—— turned piston rods and such work on a long Hendey lathe opposite me and I often wondered if I would ever be able to acquire that look of workmanlike satisfaction and amused contempt with which he would regard the world in general when he had a long cut on. F—— was quite a character in his way, tall and spare, with a sort of snapping-turtle look about the eyes and nose, and was not over well liked by the other men, for it was his boast that he could beat any man in the shop at any job, machine work or out on the floor, and could lick him afterward if necessary, both of which boasts had considerable ground, for he was strong and wiry and a "cracker-jack" machinist.

When I did get my lathe it was next his—a 15-inch Pratt & Whitney on which I was put to turning cap nuts for air-brake couplings. I marvel now to think of the quantity of those nuts we used, remembering that they were all chucked, turned and chased by boys as if they had each been so many individual jobs of lathe work, without even a sizing-die to help things along.

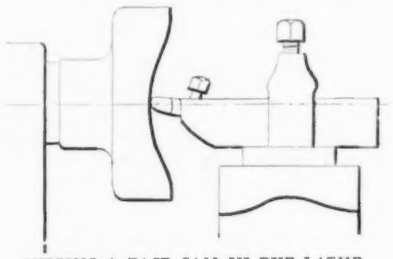
Well, F—— used to come over and watch me, saying little or nothing as a rule till he had gotten me well rattled by his silent inspection, and then with a word or two which, under cover of a sneer, contained some good advice, would return to his work and ignore my existence for the rest of the day. Other times, mostly in the afternoons after he had been mellowed by a visit across the corner during the noon hour, he would come down to the end of his lathe and yarn a bit if none of the other men happened to be near. He had been pretty much all over the American half of the globe and some of his most interesting reminiscences were of South American adventures of which he had had a plenty, and these he interlarded with copious bits of impossible jargon which he said were "Spanish."

He despised a man who could not do good work without tools and one noon hour as I was crossing the shop I found him standing in front of one of the millers on which a face cam was being cut. Suffice it to say that it was a simple cam to make two throws to a revolution and six or so inches in diameter.

"Carlos" (his "Spanish" nickname for me) he said, "Could you do that job in your lathe?"

I said "No," and in the wisdom of youth added that no one else could. He did not reply but about the middle of the afternoon he remarked suddenly as I was loading my nail keg of nuts on a truck to take to the store room, "Yes, I cut a cam just about like that on an old lathe, older than you are, down in Peru once, and it was a good job too."

"A face cam like that in a lathe?" I



CUTTING A FACE CAM IN THE LATHE.

asked, for he was no liar about his work.

"Yes, cut it with a tool in the tool post and no special rigging; there wasn't a milling machine within a thousand miles of me."

We worked together in that shop, side by side most of the time, until the shop went out of business, but he would never tell me any more than that, for if he had any delight on earth it was to pique your curiosity and then not satisfy it. "If you ever have to do it you'll think it out fast enough," he would say and then grin. I often thought over it and oddly enough the other day after sending out just such a cam to be cut because I had no miller, and getting it back the next day with word that the parties I sent it to could not do the job in time, the thing came to me all in an instant.

This particular cam was to go on the lathe spindle as a former for another little cam job which proved interesting and satisfactory enough to deserve mention by itself. It was therefore screwed on the spindle like a face plate; in fact it was a face-plate casting, a solid plate for a chuck, turned down to about 4 inches in diameter and faced up true in position. Otherwise, it would have been chucked in the regular way. The throw was to be 5/64 inch, two throws per revolution, that is, a high and low section on alternating quarters.

The first operation was to gear the lathe up to cut one thread in 5/16 inch, (or 20/64, four times the throw of the cam), as it had to give 5/64 movement up or down for each quarter revolution. By compounding the gears I got the desired travel exactly, which was partly good fortune. I next laid the blank off in quarters on both the periphery and face, using a scribing tool (which I kept for such jobs) in the tool post and doing the indexing by the large gear. Next I took an ordinary tool-holder with a ¼-inch square cutter and grinding the latter to a round nose inserted it with the cutting edge in a vertical plane as shown in the sketch, and set it so that its center was true with the center of the spindle up and down. This adjustment being very important, the tool-post washer was turned upside down and liners used to bring the tool up to the center so that it could be knocked sidewise without disturbing the vertical adjustment.

The carriage gibs were then tightened a little, the lead screw thrown in and the spindle turned until the tool was brought almost up to the face of the cam, the tool then being knocked around until when one of the cross lines laid off on the face of the cam was precisely horizontal and the other vertical, the tool would just scrape the face of the cam at the horizontal line as it was moved across the carriage with a planing action by the cross-feed screw.

That's about all there is to it; the rest will be clear enough to most readers by this time. The spindle was rotated a trifle—about 1/16 inch on the rim of the large step of the cone at each pass—and starting with the tool at the back of the lathe it was fed across by hand, cutting its way, and then returned and the spindle rotated a trifle more and so on, the carriage advancing toward the headstock and the tool going deeper each time until the spindle had made exactly a quarter of a turn. A roughing and finishing cut were necessary and on the finishing cut the "feed" was made as fine as possible, the tool marks being almost invisible on account of the blunt round-nosed tool.

One-half being finished, the cut taking in two quarters as the tool was fed right across the face, the other half was cut the same way, reversing the lead screw and turning the spindle backward, the carriage feeding toward the headstock as before. The nicety with which the cuts joined up at the bottom was decidedly satisfying, and with a little careful smoothing out of the tool marks with a fine file the cam made an excellent job; it was cut truly, properly pitched and absolutely radial at all points, this last being in this case of the utmost importance.

Aside from the time of turning the blank it took just three hours and a quarter to cut the cam, finished ready to use. It would have taken nearly that long to take it to the nearest shop equipped to do the work in the orthodox way, to say nothing of the time they

would have taken to do it and to get it back again. Furthermore this was on a Saturday afternoon, and I had planned to work Sunday on the rush job for which the cam was to be used.

True, I got just a little tired of twisting the cross-feed handle back and forth and nearly wore a hole through the heavy buckskin glove I put on my right hand after the first half hour, but if I had a dozen of those cams offered me to make at a pretty good price I believe I would gather them in, disconnect the cross-feed screw, rig up a crank-shaft and connecting-rod to give the reciprocating action to the cross-slide, belt it up to about twenty strokes a minute, and turn them out in "no time."

HEADSTOCK.

Machining Turbine Heads for Water Meters.

Fig. 1 shows a brass casting and Fig. 2 a special lathe chuck for holding it while the outside diameter at *a* is being turned and the flange *b* faced. The turned portions should be true with at least three of the cored ports *c* and three points on the rough face *d*.

The body *A* and the jacket *B* of the chuck are made of gray iron. There are three hardened tool-steel jaws *C*, which enter the ports *c* and are set 135, 90 and 135 degrees apart respectively, in order to suit the location of three of the eight ports which are in a circle and are 45 degrees apart. The castings, which are heads for turbines in water meters, are placed against the three hardened bearing points *D*, then the washer *E* and the winged nut are put on the stud, and when the nut is tightened and the work is brought up against the banking points as hard as the resistance of three helical springs in the plunger *F* will permit, the plunger advances and forces the jaws outward to center and hold the castings. The contact face of the plunger is made to form a section of a sphere, because of the changing of the angle of the contact faces of the jaws as they swing outward.

The chuck, Fig. 3, holds the castings while turning the face *d* and boring the central hole, and consists of a hinged clamp and a face plate made of gray iron. Three hardened tool-steel jaws are inserted in the clamp, one in the upper and two in the lower part, and are ground in place. The upper part of the clamp is fastened to the face plate with three screws and two dowels. The lower part has a free movement, and is held close to the face plate with a shoulder screw moving in an elongated hole. When the clamping nut is loosened, the weight of the lower part of the clamp, aided by a helical spring, opens the chuck. This style of chuck is made at a comparatively small cost, and insures a true and secure hold. It has proven to be an ideal tool for the rapid handling of pieces that are required in quantities and of a uniform diameter. I have designed and made a number of each of the two kinds of chucks described above, for use in the works of the N. M. Co., of Brooklyn. The various sizes of chucks in use there have capacities for holding pieces ranging from 5 to 12 inches in diameter. Each chuck is made to hold one size only.

The jig, Fig. 4, for drilling the heads, consists of a gray-iron plate with four machinery-steel legs. Two of the legs are slotted and contain pins to support a swinging truss clamp. One end of the clamp contains an elongated hole by which it is hinged to one of the legs. This hole permits the clamp to be drawn toward the hinged end to clear the supporting pin in the other leg while being swung into place, and then to be drawn into position between the pin and the bottom of the slot. The clamping screw is capped with a swiveling plate. In the smaller sizes of jigs, owing to the close proximity of the larger holes to each other, a hardened, tool-steel plate is inserted which contains the holes for grinding the drill. The heads are located by five hardened pins. One of the pins and a projection on a small lever enter one of the ports, and when the nurled and beveled nut is screwed down the heads are locked in place.

The drilling is done during one handling of the heads, on two drill presses standing close to each other. The outer circle of holes is drilled on a multiple spindle machine, and the cored holes on the inner circle are finished in a single spindle drill.

H. E. R. MANBRAND.

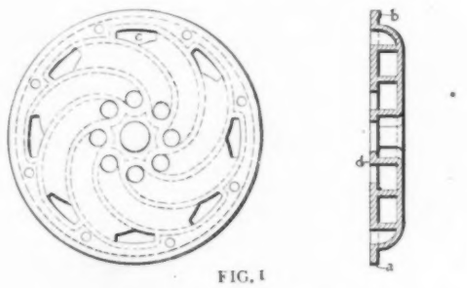


FIG. 1

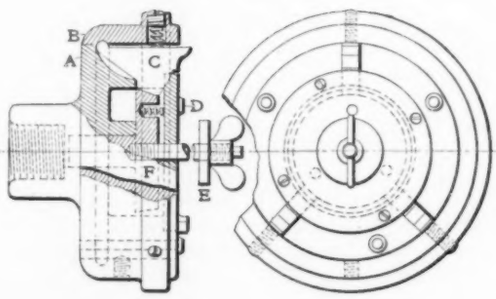


FIG. 2

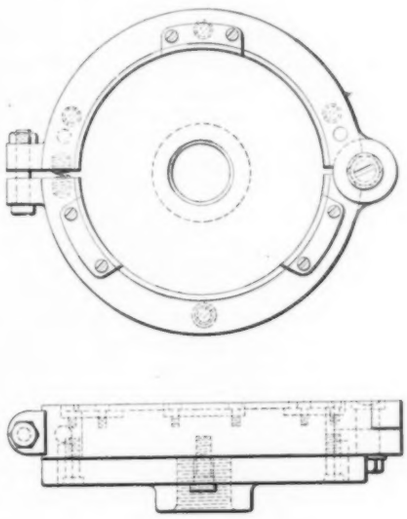


FIG. 3

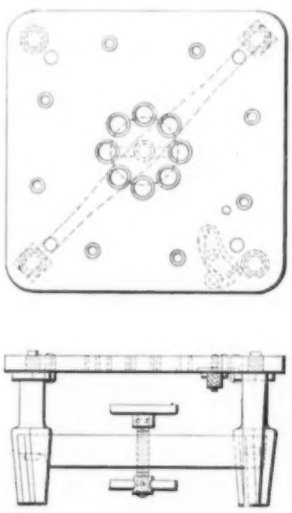


FIG. 4

FIXTURES FOR MACHINING TURBINE HEADS FOR WATER METERS.

A File Rack.

In another place I refer to the improper care of files and it will perhaps be of interest to some of your readers to know of a very cheap and convenient file rack I had put up in one place in which I worked. On the wall directly back of the vise above the bench, were fastened two strips of wood 1¼ inches thick placed like the two sides of the capital letter A, about 12 inches apart at the bottom and 4 inches at the top. Holes were bored in these at intervals, the same number and the same distance apart in each, and in these holes were driven hard wood pins 7/16

inch diameter and projecting from the face of the strips from 1¼ to 2 inches, the shortest being in the top holes. The files were laid on these pins, 14-inch ones at the bottom and shorter ones higher up. I insisted on having a handle for every file I kept on this rack, and the body of the files rested on the pins, the handles all projecting to the right. The pins should be spaced far enough apart so that there is room enough between the handles to get hold of the handle of a file and take it from the rack without disturbing the adjacent ones. I believe no one can fully appreciate the economy and convenience of this simple and cheap arrangement until he uses it daily. If it is desired to lock the files up it is not very expensive to make a wood frame with a door and lock to cover the rack. BELL CRANK.

Systematic Economy in Making Drawings.

Probably some risk is taken in writing a reply to an article which has appeared in the columns of the AMERICAN MACHINIST, that savors of criticism, for the reason that the writer is likely to get a stronger dose of his own medicine. Yet at different times certain statements have been made, contrary to what practical experience with the subject discussed has led me to believe was correct, and I have therefore decided to run the risk and make a statement directly opposed to one which recently appeared in your columns.

The article at page 546, on Systematic Economy in Making Drawings is the one which has stroked the fur the wrong way. When the author of this article stated positively, allowing no exception, the one sentence, "Drawings should not be checked," I felt that I was at the blowing-off point and had to open the safety valve to let off steam. We have always considered very careful checking of drawings absolutely essential, and it is one of the things which we watch very carefully, and are very rigid in seeing that it is done thoroughly. All who are concerned in our plant agree that it is one of the most essential parts of our system, and never a question has been raised to the contrary. The reasons given in the article quoted for not checking drawings are that it weakens the draftsman and takes unnecessary time. The extent of weakening depends largely on what the draftsman is given to expect will be the consequence of his errors. It might be possible for one to grow careless by thinking that the checker will catch the mistakes, but not so if he has his heart in his work. In our drawing room advancement is made solely on merit, and the man who makes the least mistakes, other things being equal, is the first in line for a raise. This being understood, I believe the utmost care is taken in making drawings, more so than in the average shop, and yet in checking serious mistakes are sometimes found which would prove costly if they were not corrected.

It may be that in some shops mistakes are very few, especially if the output is simple, or exceptional draftsmen are employed, but no one is infallible, and in checking serious mistakes are sometimes caught. Sometimes the checker will make suggestions which will cause a reconsideration of the design, and result in simplification or improvements of value.

I believe in economy, and it is the duty of all connected with a business to aid in reducing the cost of the product, but I also feel sure that if we abolished the checking of drawings it would be the acme of extravagance. Even the occasional omission of a dimension which causes the workman to inquire of the foreman, and the foreman to make a trip to the office, would cost, through delay and annoyance, many times the cost of checking, let alone an incorrect dimension and the consequent ruin of a lot of 50 or 100 pieces on which much valuable work had previously been done. Again incorrect projection, insufficient explanations by notes, omitted dotted lines and the hundred and one other things which a draftsman must watch, will cause much confusion and trouble in the shop if not correct.

In our drawing room, each man checks his own drawing after it is finished, and then traces it. This gives him an opportunity for a second checking. Then both drawing and tracing are turned over to another who again checks them. Even with all this care, serious mistakes sometimes, though very rarely, go through. I should not like to venture on an opinion as to what would happen if we were to grow more lax, but it is certain that the errors would be more frequent. So much for checking, and if there is any way of securing results without this precaution, I should certainly be glad to learn of it.

The "modern method" of showing screw threads shown in the same article has also received our consideration but it was discarded because it caused too much confusion on a complex piece where there were many dotted lines. For simple bolts it would do very well but I believe it better to use only one form on all drawings in showing a particular operation, so that when accustomed to it the workman will know, without doubt, what is intended. Two or three years ago, Sibley College, Cornell University, made inquiry of several hundred manufacturing concerns throughout the country regarding their drawing-room practice and asked for reasons for their various methods. As a result of this inquiry many answers were received and a system was adopted at the University consistent with the best shop practice. The method of representing screw threads was one of the items discussed, with the result that they have adopted the method shown in the article at page 546 as the "practice of ten years ago," with the difference that instead of sloping the threads they make them straight or at right angles with the center line of the tapped hole or the threaded piece. We thought that their method of concluding that this was best was a good one and we have adopted it with very satisfactory results.

We all strive for economy in its broadest sense, yet I contend that we can only know what that economy is through the results of actual experience, and our experience has been such as to convince us that the foregoing methods are the best which we have yet discovered. No doubt in different lines of manufacture with their varied conditions, what would be economy with one would be the reverse with another and I would not venture to say positively that it is impossible that certain conditions might exist where the checking of drawings would be unnecessary. But I certainly cannot conceive of such conditions in any modern industrial plant where working drawings are extensively used. I feel sure that an attempt to save time in our drawing room in the manner and degree which the author of the article referred to advocates would cause worry and time lost equal to many times the labor saved for the draftsman and would be disastrous to the regular shop routine. L. F. B.

Some Peculiar Machines.

We regret that we cannot reproduce the illustration which was received with the following letter:

"Under this cover please find page torn from a daily paper published in this city. After a great amount of study and consultation with machinists we have given up trying to find out what kind of machine tool the machinist in the picture is using, and appeal to you for enlightenment on the subject. We have tried to decide that the machinist is trying to pull out a pin, which has become lodged in the bevel gears, with a pair of outside calipers, but knowing that this is impossible it may be that he is trying to twist his calipers so he can caliper around the corner with them.

"We also note that two wires lead out from what appears to be a motor, and connect with the teeth of the bevel gear, thus getting commutation for the motor, and drive for the machine from one gear wheel; this may be new practice, but we have seen nothing of this kind before.

"Behind the railing at the left of the picture we have another peculiar machine. A fly-wheel supported by a shaft running through the spokes, driving a crank disk, through the pinion, onto the gearless periphery of the crank disk, connected to a guideless cross-head, driving a ——— well, really what we would like to know, which end of this machine is the power applied, and what duty does it perform?

"We will admit that we are a little

slow here in Portland, but little did we think that mechanics would take such rapid strides, that we are completely lost in the progressive manufacture of new devices "made in Oregon."

"Any advice on the machine would be gratefully received by

A CONSTANT READER
OF THE AMERICAN MACHINIST."

Press Tools for Pole Punchings.

The accompanying sketches show a combination punch and die for producing laminated steel plates for pole pieces used on railway motors, also a plain punch and die for punching the end plates for these parts.

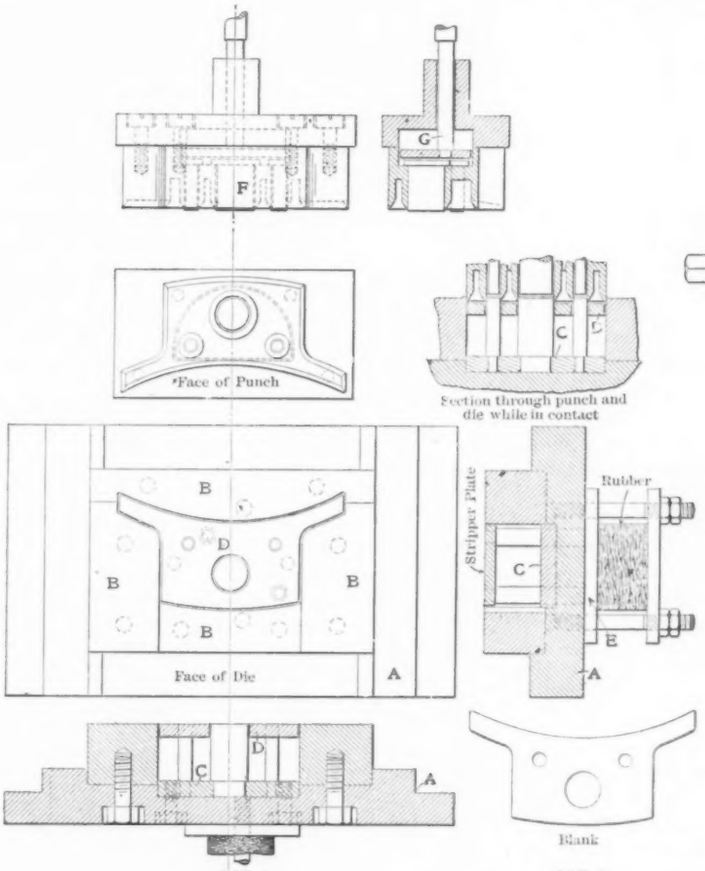


FIG. 1 FIG. 2

PRESS TOOLS FOR POLE PUNCHINGS.

In Fig. 1, are shown the combination tools and it will be seen that the die proper is composed of a plate *A* (of gray iron) and the four pieces *B*, which are hardened, ground, fitted into place and secured by screws let in from the bottom. The inside circular punches are riveted to the steel plate *C* which is also fitted into the plate *A* and bolted fast from the bottom.

The stripper *D* is a mild steel plate machined to clear the interior of the die and drilled to clear the circular punches. Two steel studs are riveted to the stripper plate, these studs extending through plates *C* and *A* and resting on the plate *E* which in turn rests upon the rubber cushion.

The punch *F* is of tool steel machined to the shape shown and fitted closely to the die. This punch is worked out, beveled almost to an edge and left unhardened; therefore, when it shows signs of wear it is hammered (or flattened) around the edges without being removed from the press, then brought down into the die and sheared to size. This can be repeated a number of times, before taking the punch out of the press. In the elevations and sections will be noticed the method of ejecting the scrap material from the inside of the punch. Loose plugs are fitted into the punch holes from the top, then the plate and knock-out rod *G* are let into the punch-holder as shown; all these parts should fit very free so as to insure working properly. As the punch ascends after each stroke the knock-out bar in the Bliss press comes in contact with the rod *G*, clearing the punch of scrap. An outside stripper (not shown) is also made to remove material from the punch.

The vertical section through the punch and die in contact shows the action of the inside stripper *D* also the method of holding the circular punches in plate *C*. The finished piece is shown in Fig. 2.

Fig. 3 illustrates a plain punch and die for the end plates which are punched (in this case) from steel ⅜ inch thick. The die is of tool steel, one piece, machined to shape and hardened, then hollow ground so as to ease the cutting. The punch is of tool steel made in one piece and hardened.

The method of building the pole piece is shown in Fig. 4 with the end plate and rivets in position. The larger rivet is also drilled and tapped to be used as a nut for holding the pole piece to the frame of the motor.

YANKEE.

Manchester, England.

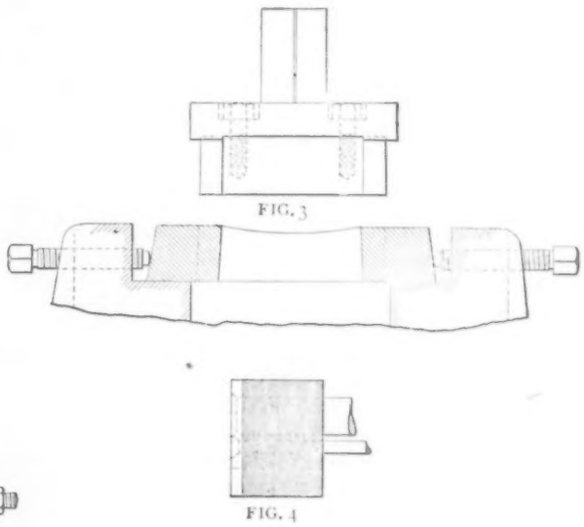


FIG. 3 FIG. 4

Rig for Handling I-Beams.

Having a number of I-beams to drill, some of them being 15-inch and weighing about 600 ponnds, we began looking for a way to handle them. One of the roof truss chords was directly over the drill and about 18 feet from the next chord. We took a 2½-inch pipe, 19 feet long, put a coupling on each end, drilled an 11/16 hole in each coupling, took a ⅝-inch steel rod about 4 inches longer than the distance between the holes, threaded each end, then bent the ends at right angles long enough so they would go through the couplings and leave room enough for a nut on the inside. When the nuts were drawn tight, the rod had about 10 inches sag in the center. We put a 2x3-inch piece of wood between the

rod and pipe, though an iron piece with adjustable nut would have been better. The pipe was then fastened to the bottom chord of the trusses by iron straps.

Our carrier was a concaved wooden roller 6 inches in diameter and 4½ inches long, resting on the pipe and suspending a ⅝x2-inch iron sling with swivel hook at the bottom.

By hitching a small chain hoist to the hook and hitching in the middle of the beam, one man could easily handle the 600-pound job under the drill.

FRED. CHAPPELL.

Modified Slotted Yoke Cams.

I enclose two sketches of cams as types that are working successfully. In some classes of work, the pin and slotted sliding bar, or Scotch yoke, are used a great deal and with good economy, and various modifications may be made to get almost anything from the simple harmonic motion to very peculiar resting motions.

Fig. 1 shows a very simple and cheap application of this principle to get 120 degrees of rest.

Fig. 2 shows an application I saw on a ramming mechanism for a cartridge-loading machine in use by the U. S. Government.

R. J.

Designing a Boring Mill.

The recent article on "Designing a Boring Mill," by Entropy, and the rejoinder by Mr. DeLeeuw seem to call for some word of warning to the young men who are studying in our technical colleges, since from either article it would be possible for them to get the idea that nothing but experience will be of future value to them in the field of design.

There are two distinct ways of approaching an undertaking of this kind; one by considering all the requirements as to chip to be taken, feeds, etc., approximating as closely as possible the stresses set up in all the different members, and taking into account as far as possible the question of convenience of operation. The completed, or partly completed, design must then be gone over and reduced to commercial requirements of weight and expense of manufacture which are included in the cost. If it is designed in the first place to be as perfect as possible from this point of view, it will have to be cut down immensely in cost to enable it to be sold from the majority of shops. This fact of the varying prices, in some cases two or three times greater than in others, that can be obtained by different manufacturers is often the most important item to be taken into account.

The other method is to get a thoroughly good idea of what other successful builders of about the same class are doing and go them a shade better. This latter method involves a complete familiarity with the subject that can only be attained by long experience with the special class of machinery in hand, and even then the merest details must be followed almost slavishly or the result will be to call down the wrath of the "regulars" without stint. If one is to use this method he must expect to find every man already in the business ready with a club looking for the most trifling things which they call errors. The only chance to get even with them is to get them off onto some subject on which they are not so well posted, and let them hang themselves with their own rope.

The first method outlined above is the only one which it is possible to teach. The other can be picked up, but woe to the man who picks it all up in one shop if he ever leaves there. But there is one thing which can be instilled into the student's mind, which no book can do but which the instructor can, and that is a watchfulness for details which make for simplicity either in the molding, machining, erecting, running, or repairing. To do this the student must place himself in the position successively of each man through whose hands his work will pass and he must see in his mind every step of the work. A preparation in this way will do the student lasting good and will also enable him to hold his head up higher the first year or two after graduation.

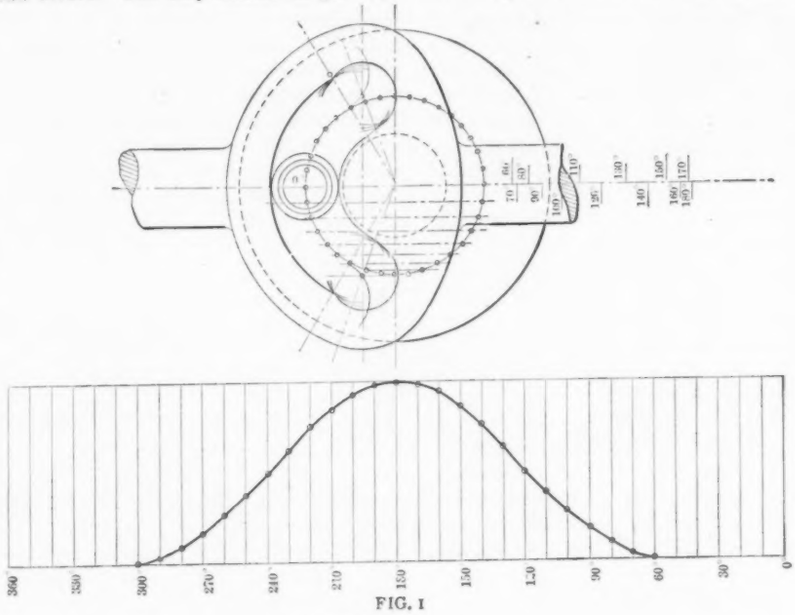


FIG. 1

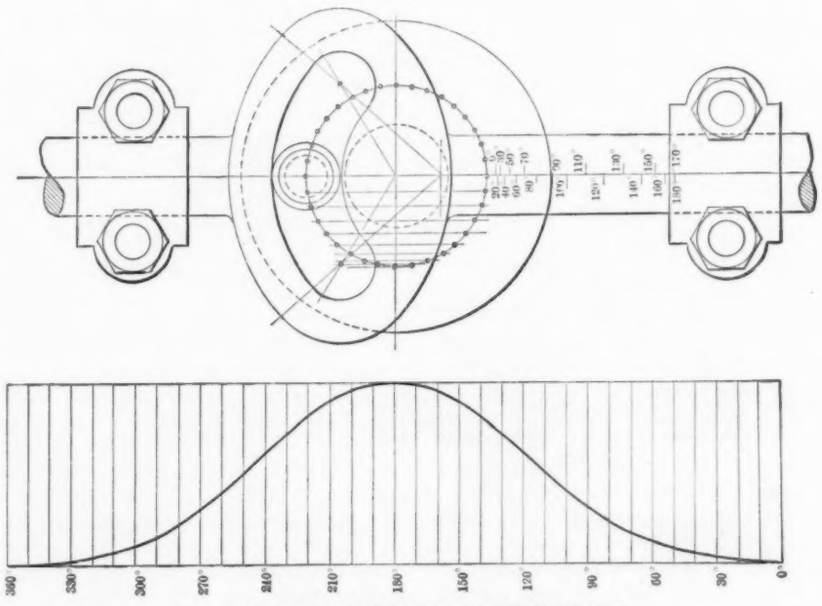


FIG. 2. SLOTTED YOKE CAMS AND THEIR CHARTS.

I wish that Mr DeLeeuw or someone else might go into this thing deeper still and get to the bed rock of principles to which it must be possible to reduce this work. The people who write books have to depend for much of their material to work on from men whose long practice and instruction enable them to jump to conclusions where there is no bridge visible to the outsider. Column after column of the AMERICAN MACHINIST and other mechanical papers is devoted to bits of experience which mean much to the

initiated but nothing to the novice. If this could all be put together and reduced to such conclusions and in such form that it could be understood and applied by men not already familiar with the "tricks of the trade" it would supplement book material already available and help bridge a gap that seems to exist between the two methods of design referred to above.

E. H. FISH.

Worcester Polytechnic Institute.

File Testing and File Economy.

The contribution to your columns on "Files and File Testing," by Mr. Herbert, marks a new departure in the treatment of the subject, and it seems to me to be the pioneer step toward a great improvement in the art of file making. The astonishing difference shown in the efficiencies of various files tested and the possible economic results which may be attained by the scientific testing and selection of files is such that it will compel recognition by all who are much interested in the use of files, and is a veritable flashlight into the dark cave of ignorance on the subject.

There is another branch of the subject in which there is generally an equal ignorance, which will have to be remedied before we can get the full economic benefit of the use of improved files. This is ignorance in the care and use of files. I assert without any hesitation that there are far more files ruined by improper use and care than are worn out by correct use of them. I have seen hundreds of files that have nearly half the teeth knocked off during the first five minutes' use. In order to have files keep sharp as long as possible they are made about as hard as any other cutting tool is ever made and the consequence is that they are brittle and break off easily. In each shop there are generally a very few workmen comparatively, who are expert in the use of files and they usually know how to get the best out of a good file but nearly every other workman in a machine shop uses files more or less and the number of files required to supply this demand is far greater than those required for the skilled file users. It is this class of file users who destroy files instead of wearing them out. Note how a workman of this class commences the use of, say, a new bastard double-cut file. It is nearly always needed for a job which has a rough surface and considerable metal to be removed. He grabs the file as if it were a buck-saw and commences to see-saw it over the work, dragging it backward as if it were intended to cut both ways and the consequence is that about one-third of the teeth are broken off during a few minutes of use. Many times I have picked up a new bastard file after about the first half-hour's use by a man whom I watched using it, and holding the point toward me nearly on a level with my eyes, would find the surface of it looking like a mixture of coarse salt and pepper, for wherever any teeth were broken off there would be the bright surfaces of freshly broken hard steel. I have often seen files abused in this way until so many of the teeth were broken off that they were made practically useless for any effective work. But this is not the only abuse they get. Files are generally common property among this class of users, and it is seldom that any are individually cared for, except where a workman has frequent use for particular kinds of files which are not easy to obtain, when he will keep them hidden or locked up for his particular use. The usual place to keep files is in some convenient drawer where all kinds and sizes are carelessly put in a disorderly mass. When a man wants a file he goes to this drawer and fishes out the best one he can find for his purpose, wasting a lot of time doing this, and when he gets through with it chucks it back in the drawer without a thought of the consequences. What teeth are not broken off at the start are soon dulled by being slid over other files and pawed around in the drawer. Every one who has had a varied experience in shops knows that what I have described is not a dream but only a statement of hard facts. No matter how perfect files may be made we will never get the full benefit of them until a better system of using them is put in practice.

I think the time is coming when each shop of large size will have a file expert who will inspect and select all files used by the shop instruct the workmen in the use and care of them and have complete control of the distribution of them and of the system for holding each man responsible for the care of the files he uses. In other words he will be a sort of "Professor of File Engineering."

To get files properly taken care of I believe it will be necessary to provide each man who uses files, with a sort of file case, in which are suitable racks for holding all the various files he needs and which must have a lock and key so he can prevent others from using them without his consent. When the proprietor of a shop learns from Mr. Herbert's experiments, that it is possible he may be using files which will do only one thirty-fourth as much work as others that may be had at the same price, he might at once conclude that by putting in a file tester he might reduce his file bills to a small fraction of what they now are, but it is quite possible in some shops where most of the files are abused instead of being properly used, there would be no striking reduction in the file bills by the purchase of good files only, for a good file may be ruined by improper use almost as soon as a poor one.

With regard to the possibility of a revolution in the process of file making which would produce a stronger and better shaped tooth, it may be noted that there are two things which will operate to prevent this. One of them is that there is a continually smaller use of them relative to the amount of machinery produced, and the other is that the cost of producing more perfect teeth may prove to be so much greater that it will lead to methods of producing work which will not require the use of files. Files may indeed finally become to us only a sort of necessary evil, but while we must use them, we may as well have the best if they cost no more than the bad ones.

BELL CRANK.

Eyeglasses with Reflectors for Toolmakers.

For several years I made tools for novelties, jewelry, etc., and the use of the eyeglass is common in that particular trade or branch of machinists' work. I never could get well accustomed to the screwing of the holder into the eye cavity and gripping it there, that position and practice was never agreeable to me. I put an elastic band around the head and had it attached to each side of the eyeglass. This arrangement held the glass in place with gentle pressure; and, what was of still more importance, it held the glass against the forehead, out of the way, whenever I used the unaided eye. There is another thing that ought to be added to the eyeglass—that is a reflector. I don't mean the elaborate affair that surgeons use when looking down your throat, though I admit something of that sort might be desirable; but it is too cumbersome for me and is much too expensive, I fear, for most of us. I found the advisability of a reflector when looking at the face of wide punches or similar flat work. The surface gets in the way of the light, and if you turn your back to the source of light, your head is in the way. Of course there are intermediate positions, and the workman strikes a balance as well as he can. Now, if you fit a piece of white cardboard, strong paper or a strip of tin at the end of the eye-piece, you have a working imitation of the surgeon's reflector and have the advantage of him in having a magnifying glass in combination with it. The cardboard, paper or tin is shaped like a washer, the small hole fitting the nozzle of the eye-piece. I don't want to claim too much for this scheme, but it does help a whole lot in looking into a cavity in a die, whether the work be large or small, easy to lift or otherwise. I have often used a piece of paper in the hand for the same purpose that a side reflector comes in useful for illuminating the stage of a microscope. "All roads lead to Rome." More than once I have had a notion of getting one of those five or ten-cent looking glasses and bending the metal support so that it would fit the eyeglass at the side, and I could adjust the small mirror and get a really bang-up workmanlike reflector. I never

got to that point, but I suppose it would prove very useful. A good many years ago I regularly had to lay out some large frames where the light was not any too good, and where it was not convenient to turn the machine or the building around because I wished to scribe a few lines. It is wonderful what a help a piece of paper can be in a job of that kind, though it is not so good as a lamp and may be no better at the best than a well whitened wall.

ROBERT I. CLEGG.

Filing American Machinist Articles—Contracted Multiplication—Decimal Point on the Slide Rule.

I have seen numerous methods of filing the AMERICAN MACHINIST described in your paper, but have not yet come across one to suit my requirements, and as necessity is the mother of invention, I had to manufacture one, and now give the particulars of it to your readers for what it is worth. I did not want to file away the whole of the AMERICAN MACHINIST, but only articles relating to the particular line of engineering I am engaged in, or anything useful which might prove of value as general knowledge. I am hardly right in saying I manufactured it, but more correctly appropriated an article which was used for another purpose.

I obtained a letter file about 12 in. long by 9 in. wide, of the design which has two circular wires, one folding inside the other for holding the papers, the latter requiring two holes punched in them the exact distance apart to suit the wires. These punches are supplied by the makers of the files and are of simple construction. I next divided the file by using stiff drawing paper and lettering them from *A* to *Z* in the usual manner, so that any one letter did not hide another, and then prepared a number of sheets, which were punched and were of such a size that when inserted into the file they did not cover the alphabetical list of letters on the dividing sheets, which were printed on the right-hand side, one above the other. The articles to be filed were pasted on the prepared sheets, not the dividing ones, and put under their proper letter. On the top right-hand corner of these sheets I also printed the first three letters of the article they referred to, and arranged them in alphabetical order in each compartment, so that it would be easy to find an article if there were quite a quantity of sheets in any one compartment. By compartment, I mean the space between any two of the lettered sheets, and it must be understood that these were not fixed in any way, but simply punched and put on the wires so that they could be turned over with the other sheets, and simply formed a division between any two classifications of articles. The great feature of this method of filing is, that it can be extended to any conceivable number of files, even so far as having a separate file for each different letter.

A method of multiplication which is preferable to the old style, especially when decimals are multiplied and the answer is wanted to a definite number of significant places, which is more often than not the case with engineers and draftsmen, is known as contracted multiplication. It is found in most textbooks on practical mathematics, but is not so universally used as it should be, and I will describe it for the benefit of those readers who are not acquainted with it. For example if 6.293 × .372 is required to three decimal places, first, place one under the other as shown, that is, with the decimal point always directly under the decimal point. Next draw a line after the fourth place of decimals, the general rule being, one more than the number of places of

```
6.293
 .372
------
1.8879
 .4403
 .1024
------
2.3406
------
```

decimals the answer is required to. Multiply, starting from the most significant figure, that is the 3, and as it is one place to the right of the decimal point, place the first figure of the result, 9, one place to the right of the last figure in the top line. When the last figure of the first or any result comes against the line which was drawn in the position above described, the last figure in the top line, in this case 3, can be crossed out and the remaining figures multipled in turn by 7. Similarly the 9 is crossed out before multiplying by 2. The three results are added up in the usual manner and if the last figure is 5 or more the figure preceding it is increased by 1. Thus, the product to 3 places of decimals in this example is 2.341.

I also wish to say a few words and give two rules for finding the number of digits after making calculation by slide rule. The first is as follows: Make two columns and head one × and the other ÷. When the slide projects to the right after multiplying place a 1 under "×". When the slide projects to the right after dividing place a 1 under ÷. Subtract the sum of the 1's in the "×" column from the sum of the digits in the numerator, also subtract the sum of the numbers in the "÷" column from the sum of the digits in the denominator. The difference of these two differences gives the number of digits in the answer. The other rule can be used when the cursor of the slide rule is fitted with a pointer and graduated in 5 parts on either side of the pointer and numbered from 0 to 5; the 0 being opposite the pointer, and one side being marked minus, and the opposite side plus. Every time the slide projects to the right after multiplying move the pointer one on the "minus" side. Every time the slide projects to the right after dividing, move the pointer one on the "plus" side. The difference of the digits of the numerator and denominator plus or minus the number the pointer is at, gives the number of digits in answer.

TROCHEE.

Moriarity Apologizes to Dixie.

Have you ever noticed how if you hear a new word or phrase you are almost certain to run across it shortly after, or if you look up a definition someone is sure to refer to it within a week? I looked up the value of a "coulomb" the other day and found it to be an ampere-second; the next morning I received the enclosed letter from my old friend Moriarity.

PHILADELPHY, March 28, 1906.

My dear Dixie:

Oi write ye a few loins t'appollygise. Me thot would sooner foight nor ate, an' sooner do aither o' thim nor appollygise. Ye know how me an' th' iditor o' th' AMERICAN MACHINIS' paaper called ye down lahst year fer th' way ye spoke ill o' technical graduates and min o' idication an' refoinmint. Ye will no doubt remimber the way Oi imprissed me own soide o' the argymint wid a left hook to the jaw th' last toime I saw ye in Philly. Oi taake ut all baack.

Oi hov been taakin' a corryspondince coorse in electhricity fer th' past month. Afther th' first paymint was made th' young maan brought me a foine set o' books. Ye know what graate maan Oi am fer readin' litterchure, so ye'll know ut wasn't tree days afore Oi knew all there was t' know about electhricity in them books and was lookin' fer more worlds to conquer like Napoleon Boneypart crossin th' Rubicund. Fortune favored me and wan day Oi saw on a sign boord, "Lecture on electhricity at th' University undher th' auspices o' th' postgraduate class o' electhrical ingineerin'. A discussion will follow." Ye know a discussion was always meat and drink an' th' breath o' my body t' me, so I wint an' me bowld post graduate, thot done th' lecturin' gits up—he had been sittin' down whin Oi came in—an' instid o' an *electhrical* post-graduate they ought t' hov advertoised him as a *tellygraf*-post graduate, for there was more nor sivin foot o' him when he unfolded himself like wan o' thim Dutch foldin' rules wid inches on wan siode an' centipedes on th' other. Af mere length an' a total disraygard fer th' ethics o' electhrical larnin' are the only requisites necessary he would make a foine receiver fer a wireless tellegraf station. Oi will pass over what he said in his lecture; he blithered fer a matter o' an hour and a half and thin he sez, sez he, "af they's annyone here would loike t' ask anny questions Oi'll be plazed an' honored t' answer thim." Thot was what Oi was waiting fer and Oi jumped t' me feet, at

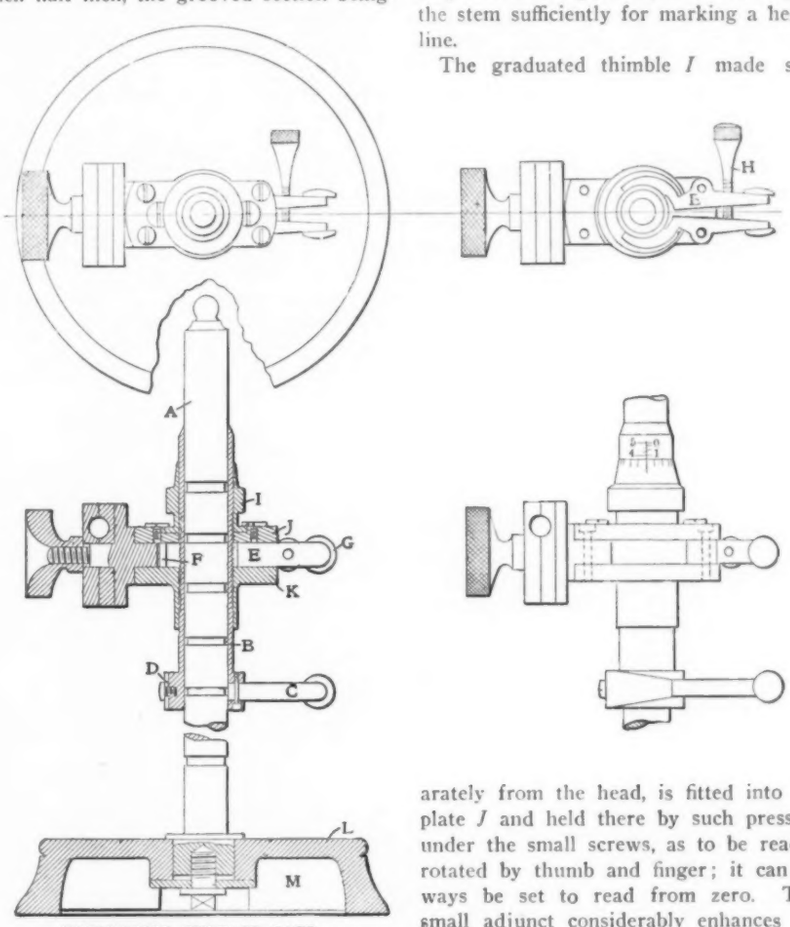
th' same time Oi peeled me coat off an' hung ut on th' baack o' me chair. "Ye say" sez Oi, "that an oom is a eunuch o' raysistance". "Yes," sez he. "Further more," sez Oi, "ye say ye can't hov raysistance without heat." "Thrue fer you," sez he. "Thin," sez Oi—an' Oi spit on me lift mitt an' in the excitement o' th' moment Oi rapped th' bald head o' the maan in front o' me wid me roight fist—"phwere th' h—l do yez get them *cool* ooms ye've been talkin' about t' this poor misguided audience for th' past hour an' a half. TERENCE MORIARITY.

P. S. They's some foin foighters among th' ingineerin' studints, me lift oi is slightly dishcolored yet.

A Micrometer Gage.

The drawing shows a gage that can be adjusted by thousandths to any hight within its capacity.

The stem *A* of this gage is grooved at each half inch, the grooved section being



MICROMETER SURFACE GAGE.

a truncated V. Accuracy in the spacing of these grooves is an essential. The sleeve *B* is made a very neat fit on the stem and is accurately threaded to 50 threads per inch. Its position on the stem is secured by levers *C* which form a split clamp. These are pressed into the groove by spring *D* and may be instantly released by pressing the knob ends. The sleeve can thus be quickly set precisely to any half-inch position on the stem without disturbing the existing setting of the scriber.

To insure accuracy these levers, as also levers *E*, should be made in one piece and afterward divided. Care should be taken in the case of parts *C*, to provide clearance between them and the bottom of the groove so that all slack shall be eliminated.

The sub-division is obtained directly from the screw. The levers *E* form a split nut and the spring *F* keeps the threaded portion pressed into the thread on the sleeve *B*. Then by pressing tips *G* the head is instantly released and can be set at any point within the half-inch division to within 1/50 of an inch. The further sub-division into thousandths is obtained by rotating the head upon the sleeve and setting to whatever line is required. The clamping screw *H* secures the whole firmly upon the stem. The sleeve, being very thin and a good fit, is found to grip the stem sufficiently for marking a heavy line.

The graduated thimble *I* made separately from the head, is fitted into top plate *J* and held there by such pressure under the small screws, as to be readily rotated by thumb and finger; it can always be set to read from zero. This small adjunct considerably enhances the utility of the gage.

The plates *J* and *K* are made separately and secured by four screws as shown; their inner faces are made perfectly flat to secure a snug fit for levers *E*.

The method of fixing the stem into base *L* is found very convenient when the tool is to be taken apart for packing into a small space. It is also handy where stems of various lengths are to be inserted. The base is made of tool steel, hardened, and ground in position. The space *M* is filled with lead.

It is found to facilitate the reading of the graduated scale on the sleeve to alternate the marking as shown. This is far preferable to the usual method of placing all the short lines on one side only of the longitudinal line. W. SOPER.

Eltham, England.

Will Gears Work in Water Outdoors?

In reference to the inquiry on the above subject at page 584 I should like to suggest that a mortise wheel with wooden teeth would probably work well under the conditions given. The water would in that case furnish sufficient lubrication. I am not speaking from any experience with gears running in water, but the step bearings of vertical water turbines are made of *lignum vita* and have only water for a lubricant. I do not think that the wooden teeth would collect the ice so badly as the iron teeth. One would expect that a little ice on the teeth would diminish the friction, at least a little ice on a wooden sidewalk seems to have that result. H. V. HAIGHT.

Sherbrooke, Quebec.

House of the A. S. M. E. Sold.

The house of the American Society of Mechanical Engineers in New York, which was purchased 20 years ago for $60,000, has been sold by the society for $120,000. This increase in value represents the rise in value of land in the neighborhood, the house itself not having been increased in value. Indeed it is probable that the lot without any house upon it would have sold for the same price.

Lehigh University, South Bethlehem, Penn., will hold its commencement exercises in the Packer Memorial Church on June 14. The address to the graduating class will be given by Rossiter W. Raymond, Ph.D. The following is a summary of the degrees to be awarded: Candidates for the degree of Master of Arts, 1; Master of Science, 2; Bachelor of Arts, 4; Civil Engineer, 32; Mechanical Engineer, 29; Engineer of Mines, 10; Metallurgical Engineer, 1; Electrometallurgist, 7; Electrical Engineer, 15; Analytical Chemist, 5. Total, 106.

A reader who has noticed the numerous communications on the subject of keeping the hands free of machine-shop dirt and grease says that in his experience he has found Fels Naphtha soap to be the best thing for keeping the hands clean when working in the machine shop; one of its great advantages being that it does not require to be used with hot water but is effective with cold water.

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Rifled Pipe Lines for Fuel Oil.

Our readers will recall the articles which we published last year on the use of fuel oil on the Pacific Coast in which the extreme density and high viscosity of the petroleums of that section were referred to, and which are, in fact, so high that the transportation of the oil through pipe line has heretofore been impracticable because of the heavy consumption of power and the small delivery of oil, and the result has been the universal use of tank cars for this purpose. Many expedients for overcoming the difficulties of pipe-line transportation have been tried but without success until a recent brilliant invention by John D. Isaacs and Buckner Speed, of the Southern Pacific Company. This invention is described at length in an article in *Engineering News* for June 7, from which we have obtained our information.

Starting with the fact that water is more limpid than the oil the inventors reasoned that if a film of water could be made to coat the inner surface of the pipe it would act as a lubricant over which the core of oil would slide more easily than over the metallic surface of the pipe, and they then reasoned further that if a small amount of water were injected into the oil and the mixture were given a rotary motion as it passed through the pipe the heavier specific gravity of the water would cause it to accumulate in such a film and thus accomplish the desired result. They obtain the desired rotary motion by rifling the pipe in helical lines, somewhat after the manner of a gun barrel, and the experimental results were so satisfactory that an 8-inch line 31 miles long has been constructed. This line has been found to deliver from eight to ten times the amount of oil that a plain pipe does under similar conditions of diameter of pipe, pressure, etc.

The pipe is rifled by a rolling process. Two sets of six rollers each are mounted in strong rings so as to press the pipe inward. The rollers are skewed at a proper angle and they impress a series of helical grooves in the pipe as it is drawn through the apparatus, the depth of the indentations being about 3/32 inch.

The volume of water used is about 10 per cent. of that of the oil and, contrary to fears which were felt before the experiments were undertaken, no difficulty is experienced in the subsequent separation of the oil and water, 90 per cent. of the water used being tapped off from a settling tank. The mixing of oil and water has been tried with plain pipe, with some success as regards pumping, but the surging of the mixture in the pipe was found to lead to such a thorough emulsification of the oil and water as to involve heavy expense for separation. With the rifled pipe no such effect is experienced.

That the action of the rifled pipe is as described is not a matter of theory. A half mile experimental line of 3-inch pipe was laid before the service line was constructed, in which sections of heavy glass pipe were inserted, through which the helicoidal action was clearly observed.

The large use of fuel oil on the Pacific coast makes the subject of its distribution from the producing centers one of large importance and this invention promises to be as useful as it is unique.

Coal Cars and Graft.

Last week we commented upon the revelations of graft in the management of railroads and upon the urgent necessity for immediately raising the standard of commercial honesty generally, in insurance-company management, the meat-packing business, railroading and all other lines of business that are monopolistic in their nature or in which the circumstances are such that the public cannot directly protect its own interests. Our contemporary, the *Engineering and Mining Journal*, is especially concerned with matters relating to the coal business, and in commenting upon the revealed doings with relation to discrimination in assigning coal cars it says:

The evidence brought out at the hearing before the Interstate Commerce Commission in Philadelphia, in relation to the handling of coal traffic on the Pennsylvania Railroad, has caused much public comment and also public astonishment. The management of the Pennsylvania has always stood deservedly high in public estimation, and the revelation of corruption among its minor officials, which almost amounted to a system, was not a pleasant matter to contemplate. The heads of the railroad have promised that there shall be thorough investigation and reform; and it is to be hoped that these promises will be fully performed, as, we believe, they have been honestly made. The evidence shows that superintendents, trainmasters and other officials in charge of the distribution of cars have received stock in coal companies, and in some cases bribes in money, to induce them to discriminate, in their work, and to favor certain mines, necessarily at the expense of others. Anyone who knows the vital importance of supply of cars to the trade of a coal company will appreciate what this means.

To a certain extent this state of affairs has been known and talked about in the trade, though we doubt if more than a few knew and appreciated the full extent of the trouble. Those who knew most about it had nothing to say, because many of them profited by the discrimination; those who did not were not inclined to talk about it to outsiders; some of them perhaps, because they thought it would do no good, and others because they feared that still worse things would happen to them if they talked too freely. Still there have been complaints heard from time to

time. They were most in evidence during the anthracite strike of 1902, when it was charged that certain favored companies absorbed most of the great profits resulting from the unusual demand for bituminous coal in the East, and the high prices paid for it. Singularly enough, while the newspapers at that time were full of denunciations of the "anthracite trust," little or nothing was said of the profits or methods of the "bituminous trust." Whether this was the result of ignorance, or of some other motives, we cannot say.

Of course, there are always complaints about car distribution on a railroad serving many mines. Every railroad superintendent knows that no coal operator ever gets all the cars he asks for, or thinks he is entitled to, even when there is a disposition to treat all alike and fairly. Moreover, without meaning to discriminate, a railroad officer may naturally be inclined to prefer the company which owns its own sidings and its own yard engines, has its loaded cars ready and furnishes full, or nearly full trainloads, to the concern whose shipments may be irregular, and at any rate delay trains on a crowded line by the necessity of switching on the road. This disposition would naturally favor the larger companies at the expense of the small operators; but it is difficult to avoid.

It seems plain, however, from the evidence so far taken by the Interstate Commerce Commission, that there has been actual discrimination in the distribution of cars and the handling of coal traffic; and that this has been the result of direct bribery of railroad officials. Without doubt it has worked great injustice. On the Pennsylvania it has been especially felt in the Clearfield region, where there are many small operators, but it has not been confined to that district. Nor do we believe that the Pennsylvania officials are the only sinners. An extension of the investigation to other railroads would reveal similar conditions.

President Baer, of the Philadelphia & Reading Railroad, claims publicly that his line is free from this form of "graft." Now we do not mean to disparage the Reading management, and we hope his claim is well founded; but it is to be remembered that the coal handled by that company is largely its own property, and that the opportunities for discrimination are correspondingly small. Honesty forced upon one by circumstances is not a high form of virtue to boast about.

Perhaps the worst feature of the whole matter is that it shows so low a standard of business integrity. The railroad officers who took bribes and were therefore derelict in their duty, were for the most part men of sufficiently good repute to hold responsible positions; and they do not seem to realize that they have done anything wrong. And the men who corrupted them, and profited exceedingly by it, had an even lower standard. Neither party, apparently, recognized any other or higher motive than gain. And when we come down to that, then no man can trust his neighbor, and our estate is low indeed.

President Roosevelt has signed the bill removing the internal revenue tax on denatured alcohol to be used in the arts and industries and it will take effect January 1. Already there is considerable inquiry for machinery with which to manufacture such alcohol and there is little doubt that it will result in very great benefit to many industries and lead to the use of much additional machinery of various kinds. It is a step in the direction of allowing the American people to make and use what seems to them right and proper and which they believe it is to their advantage to make and use, and is on that account to be heartily commended. Public sentiment has been practically unanimous in favor of the bill, the only trade journal that has distinguished itself by opposing it, so far as we have noticed, being the *Iron Trade Review*, of Cleveland, which by declaring that the Standard Oil Company (also of Cleveland, originally, we believe) was not at all opposed to the bill left itself as about its only opponent.

New Publications.

Pacific Type Passenger Locomotives—A pamphlet (48 pages, standard size, 6 x9 in.) just issued by the American Locomotive Company, describes passenger locomotives of the "Pacific," or 4-6-2, type, built for various railroads. The pamphlet opens with a description of the "Pacific" type, and an outline of its special advantages for very heavy and fast passenger service. These are very briefly stated and are followed by a description of two forms of trailing trucks which have been used with great success on this type of locomotive. The description is followed by two pages of tables containing, in condensed form, the leading dimensions of all the locomotives illustrated in the pamphlet, the tables being arranged in the order of the total weight of the locomotives. The heaviest is one for the Baltimore & Ohio Railroad, 229,500 lb., excluding tender. By the use of side elevation and sectional drawings a typical "Pacific" type locomotive is illustrated and engravings of outside and inside-bearing trailing trucks are included. The remainder of the pamphlet is devoted to photographic reproductions of locomotives, the opposite pages containing tabular information concerning each design. The locomotives are placed in the order of their weights.

"Twentieth Century Machine Shop Practice," By L. Elliott Brookes. 631 5¼x7½-inch pages, with 423 illustrations. Frederick J. Drake & Co., Chicago. Price $2.

This is one of those compilations which are offered from time to time for the instruction of mechanics, but which contain so much that is misleading and so much more that is obscure that one wonders how they ever see the light. The best way to show the kind of "instruction" which the author provides is to give a few extracts from his pages. In the section on Arithmetic we are told that "an integer is a number which represents an unbroken quantity" and that "a prime number is a number exactly divisible by one," while under Algebraic Signs and Symbols we are told that "when it is desired to express division in a simple form the division is written under the dividend thus: $(a+b) \div c = a+b$." The author seems to regard logarithms as a part of arithmetic, and defines them in the following exact and lucid manner. "Logarithms are the exponents of a series of powers and roots of numbers. The logarithm of a number is that exponent of some other number which renders the power of the other number, which is denoted by the exponent equal to the former. In other words the logarithm of a number is the exponent of the power to which the number must be raised to give a given base." The section on Applied Mechanics is full of gems of this kind, of which perhaps the best is this definition of gravitation: "Force of gravity or gravitation is an accelerated velocity which heavy bodies acquire in falling freely from a state of rest." Regarding the lever we are told that "the power is to the weight as the distance of one end of the fulcrum is to the distance of the other end to the same point." The inclined plane we are told "is properly the second elmentary power and may be defined the lifting of a load by regular instalment." Under Diametral Pitch System of Gears are formulas which are wrong and hopelessly misleading. In the section on Horse-power we are told that "Indicated horse-power represents the actual thermodynamic (heat pressure) conditions within the engine cylinder but does not take into account friction or other power losses."

The sections on shop work and methods consist chiefly of a collection of manufacturer's cuts and descriptions, most of which might have been taken from catalogs and of running comments on the uses of the various tools and machines, but no instruction of any value to any one.

In the shops of the King Machine Tool Company, at Cincinnati, they had a good deal of trouble with a certain friction clutch on a machine they are building, owing to a persistent tendency to release itself. They finally discovered that this was due to the air imprisoned within the clutch when it was closed, and when holes were drilled through the disk to permit the escape of this air, there was no further trouble.

New Tools and Machine Shop Appliances.

A SHEARING PRESS.

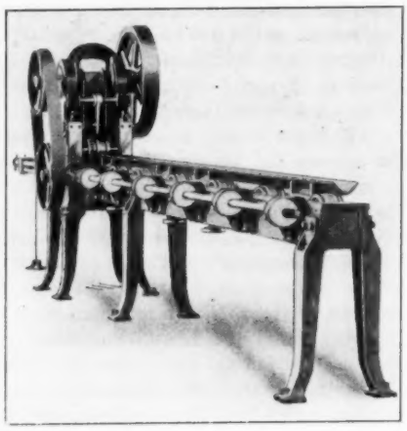
The illustration shows a press with automatic feed for cutting off bar stock from ⅜- to ⅝-inch diameter in lengths from 6 inches to 4 feet. It will handle bars up to 16 feet long. The V-shaped trough is open at the bottom, into it the bar to be cut is placed. At intervals along the machine are rollers driven by bevel gearing from the shaft at the side of the machine. The stock lies on these rollers and is fed along by them when the shear is out of the way. Two adjustments only are necessary when starting: The gage at the extreme left must be set the correct distance from the dies and the trough must be moved so as to enter the stock into the proper die.

These dies are merely tool-steel bushings. Two of them are sufficient to cover the sizes of bars previously stated, but if it is desired to have the stock cut as square as possible close-fitting dies are necessary. The stroke of the gate is 13/16 inch; weight of the machine 3095 lb.; floor space necessary, 160x27¾ inches. This machine is built by The Waterbury Farrel Foundry and Machine Company, Waterbury, Conn.

COLD SAW CUTTING-OFF MACHINE.

The accompanying illustration shows a new design of cold saw cutting-off machine designed for steel foundry use and made by the Newton Machine Tool Works, of Philadelphia. The machine is fitted with a Taylor-Newbold inserted-tooth saw which has made necessary a substantial increase in the weight of this and other machines on which it is used. The feed is variable and has a range of 18 inches through a friction disk as shown, and has also a power quick return. The work table adds to the convenience of adjusting the work to the machine.

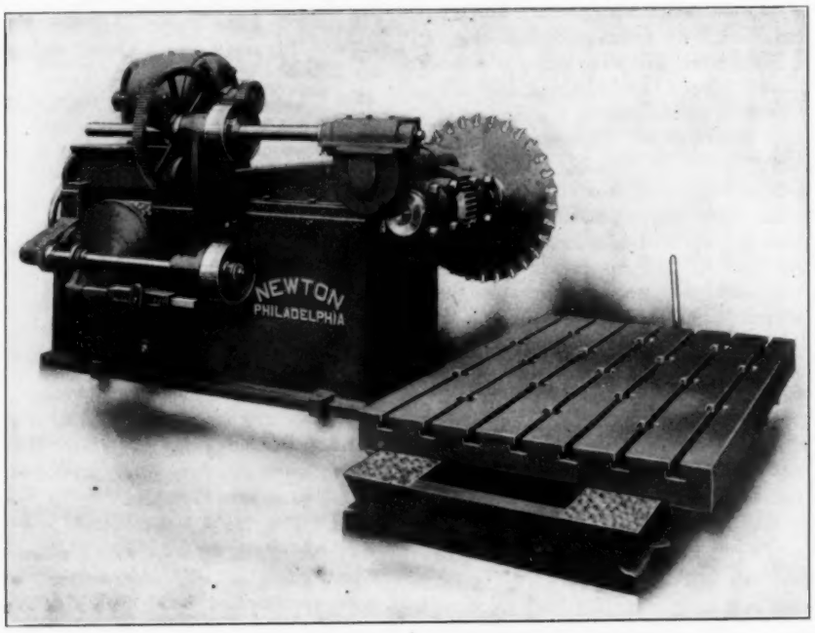
The saw is 32 inches in diameter, and has a capacity for gates or risers up to



A SHEARING PRESS.

9 inches. The machine has cut off 8x8-inch sink heads in 8 minutes, and 45 carbon stock 8 inches in diameter in 16½ minutes.

The New York State Civil Service Commission will hold examinations in all parts of the State June 30, 1906, for the following positions: Architectural draftsmen, $15 to $25 a week; bridge designer, $1,500 to $1,800; bridge draftsman, $1,200 to $1,500; chief engineer, $900 to $1,500 and maintenance. The last day for filing applications for these positions is June 25. Full information and application forms for the examinations may be obtained by addressing Charles S. Fowler, chief examiner of the commission, at Albany.



COLD SAW CUTTING OFF MACHINE.

Linseed Oil.

In a report by A. Grittner, Chief Analytical Chemist of the Hungarian State Railways, to the International Association for Testing Materials, we find considerable information with reference to a material of much importance to all users of paint, namely, raw and boiled linseed oil. The subject is considered principally with regard to methods of testing of the oils. The following brief extracts are taken from this report:

Raw Linseed Oil—Linseed oil is produced by cold or hot expression of the seeds of the common flax or lint, *Linus usitatissimum*. The cold-pressed oil ("cold-drawn oil") is of a yellow color, while the hot-pressed oil is of a yellow to brownish-yellow color, according to the temperature to which the ground seeds have been heated. The cold-drawn oil is exclusively used for food, whereas the hot-pressed oil is extensively applied for technical purposes.

Although linseed oil is denser than the oils which are usually used for its aduteration, no conclusion as to its purity can be drawn from its specific gravity, unless it is found to be below 0.928 or above 0.938. A lower density suggests an addition of rape-seed oil, mustard oil, cotton-seed oil and mineral oil; higher density would be caused by rosin, rosin oil, overheated linseed oil, or by adding a siccative.

Boiled Linseed Oil—Boiled oil is produced by heating linseed oil with substances, so called siccatives,* which give up oxygen readily. The product thus obtained should dry within 24 hours when exposed to air in thin films. It is now required that the drying time of boiled oil should not exceed twelve hours; there are even boiled oils which become hard in five to six hours.

The specific gravity for boiled oil is given as from 0.937 to 0.955. A higher specific gravity indicates that the oil has been boiled too long, or the air blast has been kept on too long during boiling or afterward, but in either case while in a warm state.

The report concludes as follows:

The preceding investigations show that the purity of a raw or boiled linseed oil cannot be ascertained by determining the saponification constant, water reaction, drying power, or the portion soluble in alcohol; for even when these results point to the sample being genuine, an adulterant may yet be present. It is therefore necessary to carry out all of the tests by which the absence or presence of foreign matter can be detected.

The tenth annual commencement exercises of Webb's Academy and Home for Shipbuilders took place June 7 at the Institution, Fordham Hights, New York City.

*Dryers.

What is Going On in Some of the Shops of the Middle West—II.*

In the shops of the R. K. Le Blond Company, though they were busy with their regular cone-driven lathes and milling machines, etc., they were found to have also gone somewhat into the matter of geared-head lathes designed particularly for taking heavy cuts with the modern high-speed steels. One lathe of theirs of 20-inch swing was designed to reduce a 10-inch shaft of steel by a cut ¾ inch deep and with feeds from 1/16 inch to ⅛ inch. One of these lathes, designed to be driven by a 15 horse-power motor, has for some time been working at the full driving capacity of a 25 horse-power motor and is in satisfactory service at that rate. These figures will be recognized as being such as would have been thought entirely inapplicable to lathe construction only a few years ago.

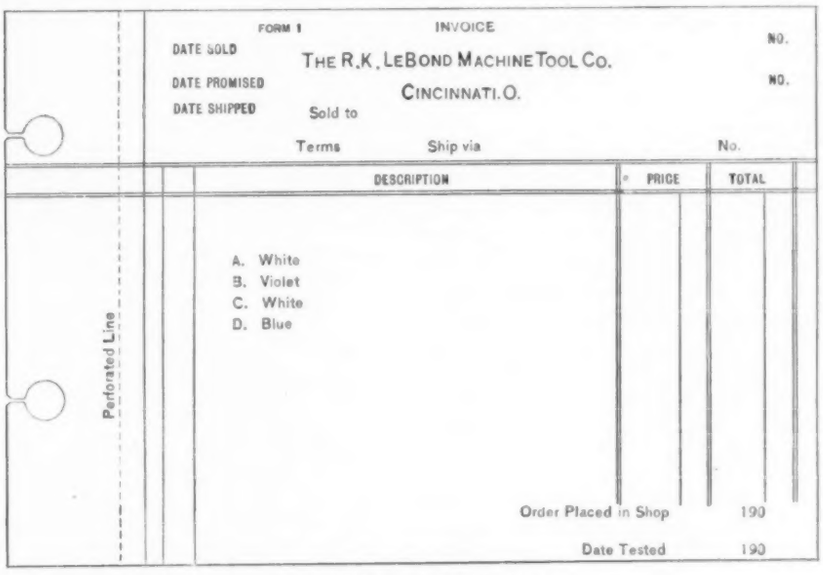


FIG. I. FORM OF ORDER BLANK.

A SHOP ORDER SYSTEM.

In the office, F. E. Le Blond, manager of the company, who has charge particularly of the business end of it, showed me his system of shop orders, which seems to have many excellent features, and which has been tried in the establishment for a sufficient length of time to prove that it works well. In this system four blanks are used for each order, and these blanks being all alike so far as the printing of them is concerned, are shown by Fig. 1, reduced, their actual life size being 6x9½ inches over all. The single point of difference between this and the others is in the matter of the perforated line which the other three blanks are without. Designating the four blanks which go to make up a set for a given order by the letters, A, B, C, and D, the colors of these blanks are as noted on Fig. 1.

These blanks with six loose-leaf binders, the purposes of which will be explained later, together with some small sheets of carbon, constitute the entire equipment needed for keeping track of all orders. When an order is received in this shop, four blanks are superposed in the order of the designating letters as indicated, with sheets of carbon paper between them, but with one of these carbon sheets cut short at the right so that the blank below it fails to receive the record of prices of the machines. This is done because the particular blank in question is the shop order, which goes into the shop when the machine is to be built and it is not desired to make prices public. The one who receives the order, with the original before him, dictates to a stenographer who fills out the blanks; and, this being done in the typewriter, with carbon sheets as explained, it is certain that all the blanks will be filled out precisely alike, and this does away with a great many chances for mistakes being made in the building of machines, where systems are used which involve the transferring of data from one blank to another. The entries to be made on these blanks are self explanatory for the most part, but it may be well to state that at the upper right-hand corner is a place for the builder's order number and under that for the customer's order number, which numbers are of course referred to in the correspondence pertaining to the order.

When the blanks have been properly filled out as far as may be at the time of the receipt of the order, sheets A, C, and D are filed together in a loose-leaf binder, which is called "Shop Orders." This binder is arranged with tabs so that the different sizes of machines may be filed in by themselves, for instance all the 32-inch millers being together, the 36-inch and the 48-inch also together and by themselves for convenient reference. The sheet marked B, is placed in a book which is called "Unfilled Orders" and these are put into this binder numerically, according to the builder's order numbers.

When the time comes to place the order for this machine in the shop, sheet D is removed from the "Shop Orders" binder and sent to the shop, along with such other orders as may have accumulated for that particular size and kind of machine. If it happens that there are not enough machines of a particular size sold to complete a lot of the number it is desirable to build at one time a special order is filled out to complete the lot. Instead of marking this order as sold to a customer, it may be marked as sold to "S"; meaning Stock. This sheet D remains with the machine until the latter is completed, and on the back of this sheet there are blanks for entries showing the inspector's test which the machine has gone through; this sheet being returned to the office after the machine has been tested and run off.

If when a lot of machines is completed and not all of them are sold, the sheet D representing the unsold machines, is returned to the office and the shipping clerk then takes all the sheets A, B, C, and D for the given machines and files them together in a binder, called "Stock Machines." Then when one of these stock machines is sold, the sheets representing it are taken out, the party's name to whom the machine is sold is written in on the typewriter, the machine shipped and the blanks go through precisely the same process as already described except that the machine is merely shipped instead of being built.

Shipping instructions are taken from sheet B, which is filed in the "Unfilled Order" binder, and after the machine is shipped, the shipping clerk takes sheet D with A and C, and hands them to the book-keeper, who is supposed to check up the prices and extensions. Sheet A, being perforated as shown, is torn off, attached to the bill of lading and forwarded to the customer, while sheet C is placed in a binder which acts as a sales-book and from which the book-keeper posts the ledger. Sheet D is then filed away in another loose-leaf binder under the particular size of machine and thus acts as a permanent record of the date the machine was built and the test it underwent in the hands of the inspector.

The loose-leaf binders referred to are named respectively: "Shop Orders," "Unfilled Orders," "Sales Book" (which last had better be bound in leather and made strong), "Stock Machines," "Record of Machines Shipped" (being sheets D after coming from the shop to the office) and a "Transfer Binder" for the filled orders (sheets B), which last can be made of canvas.

A number of manufacturers who have wrestled with the problem of shop orders and records of the same have been much impressed by the smooth and efficient

*Continued from page 605.

working of this system in the Le Blond shop and have made a special study of it. It seems to involve a minimum of work; to reduce the chances of error to the smallest possible; to afford all desired information at any time and in such shape as to be readily gotten at; all of which are very desirable and important points in a shop order system.

CINCINNATI PLANER COMPANY.

At the shops of the above-named company they were as busy as in the other shops of the city. A large proportion of their planers now have upon them the speed-changing device which we illustrated some time ago, and in which changes in cutting speed are made by a system of gearing and clutches. To relieve this device of shock and strain, a fly-wheel is placed upon it in such position that it absorbs most of the shocks due to reversing; it being found in practice that when the power is shut off, this fly-wheel will usually reverse the table about three times before it is brought to rest.

In the manufacture of this speed-changing device a problem arises which would generally be considered a little difficult, but which has been solved in a satisfactory manner. A lever must enter the oil-tight case of the device, and this lever must be free to move in any direction. This, of course, calls for a universal joint of some kind, and this joint must be oil-tight, because the case is filled with oil. It is accomplished by means of a ball-and-socket joint arrangement, which gives freedom of movement in any direction, and is oil-tight. Ring oilers are provided also, it being important in a thing of this kind to insure efficient lubrication.

A large jig attached to a part of a planer in course of construction in this shop attracted attention, because under each corner of it there were small pieces of tissue paper. Inquiry developed the fact that these pieces of paper were used in that way simply to insure that the jig was down where it belonged, i. e., in contact with the work as it is intended to be. The pieces of paper were about 0.001-inch thick, or six of them were equal to 0.007-inch in thickness. Where a piece of this paper is placed under each contact point, and when the jig is secured in place, all the pieces of paper are found to be tight; it is then assumed that the jig is surely where it is intended to be. Of course, in making the jig allowance is made for this thickness. It seems an ingenious and very convenient way of insuring that a jig is properly placed and, so far as I know, is new.

The problem of supporting shafts having a number of shoulders upon them in V-blocks for being splined, drilled or milled is in this shop solved by the use of V-block supports, which, instead of being the ordinary open blocks, are composed of V's which are laid over on their sides and arranged to approach and recede from each other by means of right- and left-hand screws in the same manner as some pipe bench vises are made. Such V's form really pairs of universal chucks which, when carefully made, will hold a shaft in alinement with the platen of the machine upon which they are placed, regardless of the diameter, and thus a shaft being, say, 2 inches diameter at one end and 3 at the other, is immediately lined up correctly without the use of blocking or any special devices.

In an annex to this shop, which they have across the street, and which was made necessary by the rapid growth of their business, I noticed a home-made hot-blast heating arrangement which is very simple and, I was told, very efficient. It consisted of an ordinary house-heating furnace placed upon the shop floor. The pipes from this furnace, which would ordinarily lead to registers in the floor above, were simply, in this case, carried about the shop to the places where it was desired to discharge the heated air, and instead of this cold air being simply drawn in from the outside, as would be the case ordinarily, it was blown in by a small fan-blower driven by an electric motor, and the results were declared to be all that could be desired.

THE CINCINNATI MACHINE TOOL COMPANY

is occupying new shops which are admirable in many respects, and which have a bearing upon a story of considerable interest. The ordinary idea of a drill press is simply a machine which will drive a drill strong enough to enable holes to be made rapidly and without much regard to the quality of the holes or the accuracy with which they are made. In fact, a great deal of drilling needs no other consideration, and almost any sort of a machine is sufficiently good to do the work, so far as that is concerned. But a few years ago the men who organized the company named above, believing that there was or could be made a demand for a first-class drill press, and that people could be found who would pay the price for such a machine, undertook to build them. When I first saw their place they were in anything but a first-class shop, but it was evident that they were doing first-class work, and that they knew how to do it. They have gone on in this way and are still building a very superior drill press, most of its parts being finished by grinding. And they seem not to be affected in the least by the condition of affairs often described by some others who are building drill presses, and who say that the prices of such machines have been so much reduced that it is useless to try to put into them such work as is expected in other lines of machine tools; this having reference, of course, not to the larger and more important radial and other drilling machines, but to the ordinary type of drill press, with which the vast majority of drilling is done. Their new shops have many excellent ideas incorporated in them, and it is hoped that we shall soon have an opportunity of illustrating and describing them fully.

For their grinding operations they have recently installed a Norton grinding machine. When I was in the shop, columns of drill presses were being ground, 7 inches diameter, of cast iron, and with a feed of 1½ inches per turn of the work, producing a beautiful finish and with a degree of accuracy which it is safe to say cannot be secured by any other method than grinding.

On the floor near the door of the office there stood a drill press crated for shipment abroad. And when I say crated I do not mean boxed. This attracted my attention, and upon inquiry it was found that experience had convinced this firm that better results were obtained; that the machines arrived at their destination in better shape with a properly made good crate around them, and properly protected from rust, than where they were boxed up tight, so that the persons handling them could have little or no idea of what the box contained and were, therefore, liable to handle it in ways entirely inappropriate to the handling of machine tools. Having tried both ways, they give their adherence to the open crate for foreign shipments, which of course is directly the opposite of the usual idea.

THE KING MACHINE-TOOL WORKS

also occupies new shops far out in the suburbs midst more pleasant surroundings than have many of Cincinnati's shops. There they are building small sizes of boring and turning mills, in which they are embodying many new ideas which we shall in due course probably illustrate. Among these new ideas is the attachment of the driving gear to the face plate of a boring mill by means of pins which engage with holes bushed with red fiber, it being declared that these fiber bushings cushion the action of the gearing and result in much smoother cuts than can be taken otherwise, other things equal. In this shop, also, grinding is largely employed for finishing parts, and they also have a new Norton grinder built, or rather designed, primarily for grinding locomotive piston rods, and with a gap near the head.

SPRINGFIELD MACHINE TOOL COMPANY.

Some years ago in talking with R. K. Le Blond, about the construction of lathe carriages with a guiding V in front, and a flat guiding surface at the rear, he stated that he had given up that construction (though he fully believed it was the best) because it required too much effort to educate customers, many of them believing that it was done to save cost in manufacturing the lathe, and being unwilling to be convinced otherwise. As illustrating differences in the experience of different shops, I found in the works of the Springfield Machine Tool Company many lathes on the floor and being

constructed in that way, and upon inquiry they said that all of their lathes of a certain type known as the "Ideal," and which they have been selling for the past five years, were made in this way, that they urge this construction as being the best and have encountered no difficulties or obstacles in its introduction.

OWEN MACHINE TOOL COMPANY.

At the new shops of the company named, an entire new management was found in charge, and they were introducing the most modern shop and cost accounting methods, with a view to better systematization of the work. I was informed that they are inclined to give up the manufacture of the special forms of milling machines which have been made by this company for some years in small numbers, and to confine themselves strictly to the standard knee type milling machines, for which there is a constant and apparently growing demand.

At the works of the Springfield Division of the American Seeding Machine Company, I saw a curious machine which illustrates the thoroughness with which some manufacturers equip themselves for studying the action of the machines built by them. This company builds large numbers of grain drills, and during recent years various forms of disk machines have been introduced by them, which have presented new problems. As they do business all over this country, and in other parts of the world beside, it is important to know as accurately as possible what a given construction will do in a given kind of soil. And so upon one of the upper floors of the building there is a machine which somewhat resembles a merry-go-round. It is about 20 feet in diameter, the ring being of a trough section and adapted to hold a sample of soil. Such soils, which are usually sent to the company by their various local agents, are placed in this and the ring is driven by power by means of rubber friction rolls, in contact with a suitably arranged band upon the outside of the ring. The planting mechanism of the machine under test is placed so that it operates in this moving earth in the same way that it would were it in the field; only that instead of the mechanism traversing through the soil it stands still, so that its action may be easily observed, and the soil does the traversing. Proper facilities are provided for changing from one mechanism to another, and for changing the soil when occasion demands, and in this way by the use of this apparatus the company can, all through the winter when outdoor tests would be impossible, make tests of different soils and mechanisms, and can make these tests with the least possible expenditure of time and trouble. This arrangement has been devised by F. R. Packham, who is in charge of the experimental department of this company.

In the manufacturing department of this company too, of which department George W. Perks has charge as superintendent, there are a lot of interesting things, especially in connection with dies for bulldozer work, which we shall probably be able to publish some account of in due time.

The dedication exercises of the Morton Memorial Laboratory of Chemistry will occur at the Stevens Institute of Technology, Hoboken, N. J., June 13, at 2.30 p.m.

We find that we were a little premature in announcing that the Merchants' Association of New York, is now located at 66-72 Lafayette Place, New York. The association expects to move to its new location in November, if the building is completed by that time, but at present it is at its old address, 346 Broadway.

The Patterson Tool and Supply Company, of Dayton, Ohio, write us that on account of the similarity of titles their concern and the W. M. Pattison Supply Company, of Cleveland, are suffering some inconvenience because of misdirection of mail. They make the request that parties writing them be more careful in the future to see that letters and envelopes are properly addressed.

The eleventh convention of the American Foundrymen's Association was held at Cleveland, O., on June 5, 6 and 7, headquarters being at the Central Armory, though one of the sessions was held at Case School of Applied Science, and another aboard the steamer during an excursion on Lake Erie. Many interesting papers were presented at the convention. Around the convention space in the Central Armory, which is a building 120x207 feet, was placed a very full exhibit of foundry supplies, there being over thirty firms in this business in Cleveland.

Max C. Zange, 417 Washington avenue, New Haven, Conn., has applied his "slide through" handle (which we illustrated some time ago as applied to a draftsman's triangle) to a Brown & Sharpe draftsman's protractor. It may be remembered that this handle possesses the curious attribute of being always upon the upper side of the tool that may be lying upon the drawing board; that is to say, no matter which way the triangle or other tool may be laid down, the handle slides through and projects on the other side, while it is flush with the side that is downward, so that it is always convenient to be picked up or moved by the handle, regardless of which way it may be laid down.

As previously announced, the summer meeting of the American Association for the Advancement of Science will be held June 28 to July 5, 1906, at Ithaca, New York. Some preliminary announcements of this meeting which have been sent to members are models in their way, one of these going so far as to present what is called "Car Window Geology, or Suggestions to Travelers Approaching Ithaca." This was prepared by H. L. Fairchild, a member of the association, and gives information regarding the geological features of the country through which the members will pass in reaching Ithaca, and which features are seen from the various railroads by which the place of meeting is approached.

Personal.

Mayntz Peterson, chief engineer of the Testing Laboratory of the Danish Government, at Copenhagen, is visiting this country for a few weeks.

E. O. Pollard, formerly superintendent of the Cadillac Automobile Company, and late of St. Louis, has accepted the position of superintendent of the Autocar Company, Ardmore, Penn.

Calvin W. Rice, who is now connected with the General Electric Company, has by vote of the Council of the American Society of Mechanical Engineers been invited to become secretary of the society and is expected to accept the position.

H. Gamper, M. E., has resigned his position at the O. S. and S. O. Home, Xenia, Ohio, as superintendent engineering department to take the position of assistant mechanical engineer with the Sherwin, Williams Company, Cleveland, Ohio.

Sidney A. Reeve, M. E., has retired from his connection with the Worcester Polytechnic Institute, and will devote his attention to his private practice of consulting engineer, particularly in steam engineering matters. His address will remain Worcester, Mass.

A. L. Monrad, who has been for the last eleven years with the Winchester Repeating Arms Company, of New Haven, Conn., in the model and gage department, has resigned to accept a position as superintendent with the H. A. Adams Tool Company, Hartford, Conn.

David O. Holbrook, who until recently was vice-president of the Pennsylvania Malleable Company and The Central Car Wheel Company has been elected vice-president of The Dayton Pneumatic Tool Company, Pittsburg, Pa., and has opened an office for the company at 717 Park Building, Pittsburg, Pa.

Obituary.

William R. Fleming, of Harrisburg, Penn., formerly president and general manager of the Harrisburg Foundry and Machine Works, died recently at Washington, D. C.

Manufacturers.

Clement Restein & Company, packing manfacturers, Philadelphia, Penn., will erect a six-story factory.

The New York Radiator Company, Utica, N. Y., has had plans made for a foundry and storage building.

A two-story factory will be erected for the J. S. Thorn Company, iron and metal works, Philadelphia, Pa.

The Parish & Bingham Company, pressed metal works, Cleveland, Ohio, will build a two-story addition.

A five-story factory is to be erected for Max Wocher & Son, Cincinnati, Ohio, makers of surgical instruments.

The Northwestern Lumber Company, whose plant at Stanley, Wis., was recently burned, will rebuild immediately.

The S. O. Bigney Company, manufacturing jewelers, Attleboro, Mass., will add another factory to its plant.

The New Jersey Pulp Plaster Company, Trenton, N. J., will erect a new plant to replace the one recently burned.

Moore & McFerrin, Memphis, Tenn., are planning to build a $250,000 box factory to replace the one destroyed by fire.

A canning company with a capital stock of $25,000 has been formed at Florence, Neb., with W. A. Saunders as president.

The Gorham Manufacturing Company, Providence, R. I., will put up another building to be used as a smelting shop.

The Van Emon Elevator Company, of San Francisco, Cal., capitalized at $100,000, will erect a plant in West Berkeley, Cal.

The Lipps-Murbach Candy Manufacturing Company, Baltimore, Md., has had plans prepared for a new four-story factory.

Johnston & Company, Richmond, Va., is being formed to manufacture paper boxes. Coleman Johnson will be president.

John Vick, of Bryan, Texas, is moving to secure the organization of a company to establish a brick-making plant in Bryan.

The North & Judd Manufacturing Company, New Britain, Conn., is preparing to build an addition to its hardware factory.

Plans are being drawn for a new factory for the Ives Manufacturing Company, Bridgeport, Conn., builders of miniature railways.

The South Atlantic Waste Company is making arrangements for rebuilding its plant, recently destroyed by fire, in North Charlotte, N. C.

The Mitchell & Van Meter Company, of Linfield, Pa., will enlarge its plant at Pottstown, Pa., employing about 100 additional hands.

Wilcox, Crittenden & Company, Middletown, Conn., manufacturers of marine hardware, will erect a four-story addition to be used as a machine shop.

The Ideal Glass Company has been incorporated at West Union, W. Va. Capital $50,000. C. C. Zenor, Alton N. Davis, John M. Gribble, etc., incorporators.

The Sterling Brass Company, Chicago, Ill., has been incorporated. Capital, $20,000. Charles P. Burbach, John S. Hunter, Fred Van Voorst, incorporators.

The McIlroy Belting and Hose Company, Chicago, Ill., has been incorporated. Capital $10,000. Incorporators, Frank B. McIlroy, Charles R. Murray, Charles G. Hutchinson.

The National Carpet Sweeper Company, Marion, Ind., recently incorporated, has plans prepared for a factory. John C. Haswell, M. L. Lewis, and others, are incorporators.

The Victory Manufacturing Company, Fayetteville, N. C., has been incorporated to make cotton goods. Capital $225,000. President, Dr. H. W. Lilly, president of the Bank of Fayetteville.

The Hicks Locomotive and Car Works, Chicago, Ill., has been incorporated to succeed F. M. Hicks & Company, and will carry on the business with increased capital and enlarged facilities.

A syndicate, headed by John R. Bartlett, 2 Wall street, New York, to be known as the Reade-Duane Cold Storage Company, has bought a site on which a 14-story cold-storage plant will be erected.

The Covell Manufacturing Company, of Chicago, Ill., making saw and tool-sharpening machinery, will move to Benton Harbor, Mich., where it will erect one of the largest foundries in the State.

The Stanley Electric Manufacturing Company, Pittsfield, Mass., in addition to the improvements now being made, will put up a building for the manufacture of steam turbines. $140,000 will be spent on the structure and equipment.

The Wyland-Newman Machine Company has been organized at Greensboro, N. C., to manufacture iron and woodworking machinery. Capital $100,000. George C. Wyland, of the Wyland Manufacturing Company, Williamsport, Pa., is president.

The Elmer Davis Company, with a capital of $100,000, has been organized at Corydon, Ky., to erect a factory for the manufacture of ice and operate a cold storage and packing plant. F. B. Hortsman, Theodore L. Black, of Louisville, Ky., are among the incorporators.

Architect Newton C. Bond, of North Adams, Mass., will furnish plans and specifications and make contracts for machinery for the new plant to be erected at North Attleboro for the Manufacturing Association of Jewelers. About $100,000 is to be expended.

Catalogs.

Challenge Machine Co., Philadelphia, Pa. Loose leaf binder containing bulletins of emery grinders and countershaft.

J. M. Westmacott Co., 161 Orange St., Providence, R. I. Circular illustrating and describing high-speed steel furnaces.

The Emerson Electric Mfg. Co., St. Louis, Mo. Bulletin No. 3703, illustrating and describing laboratory lathes for direct current.

De LaVergne Machine Company, Foot E. 138th street, New York. 1906 catalog of "Hornsby-Akroyd" oil engines. Illustrated, 6x9, pp. 82, paper.

Frederic B. Stevens, Larned & Third Sts., Detroit, Mich. 1906 catalog of foundry facings and supplies, polishers' and platers' supplies. Illustrated, 6x9, pp. 223, paper.

B. C. Ames & Co., Waltham, Mass. Pamphlet describing precision bench lathe No. 3 and attachments and circulars illustrating roughing machines, automatic screw machine and gages.

Canadian General Electric Co., Ltd., Toronto, Ont. Bulletin No. 838, illustrating and describing ceiling fan motors. Supply Catalog No. 6 of sockets and receptacles. Illustrated, 8x10, paper.

Cut Indicator Company, 150 Nassau street, New York. Booklet, entitled "The Maximum Cutting Speed. How to get It," which tells about the cut indicator made by this company. Illustrated, 3½x6, paper.

S. A. Woods Machine Company, Boston, Mass. 1906 catalog of wood-working machinery, which is a treatise on special machinery of this class and is a very comprehensive book. Illustrated, 6x9, pp. 195, paper.

Robins Conveying Belt Company, Park Row Building, New York. Bulletin No. 15, describing conveying and elevating machinery in retail coal pockets and locomotive coaling stations. Illustrated, 6x9, pp. 23, paper.

Hebrew Technical Institute, 34-36 Stuyvesant street, New York. Catalog containing calendar for 1906-1907, course of instruction, etc. Illustrated, 6x9, pp. 66, paper. Report of the President for 1906. 6x9, pp. 112, paper.

The Smart-Turner Machine Company, 191 Barton street, East, Hamilton, Canada. Catalog No. 6, describing steam and power pumps. Illustrated, 3½x6, paper. The company will be pleased to send a copy of this to anyone interested.

The Cincinnati Lathe and Tool Company, 2730-2732 Spring Grove avenue, Cincinnati, Ohio. Circular illustrating and describing Cincinnati 16-inch quick-change-gear engine lathe, with compound rest and W. T. Emmes' patent feed device.

The Phillips-Lafitte Company, Pennsylvania Building, Philadelphia, Pa. Booklet, entitled, "Do You Make Your Blacksmith Shop Pay?" This describes the Lafitte welding plates, brazing plates, welding and tempering powder. Illustrated, 6x9, pp. 9, paper.

Rotary Meter Company, 280 Broadway, New York. Catalog of rotary meters for the measurements of all artificial and natural gases, air in oxide revivification compressing machinery, regenerative furnaces, producer gas, blast-furnace gases, etc. Illustrated, 8x10½, pp. 31, paper.

American Blower Co., Detroit, Mich. Catalog No. 194, describing engines for small direct-connected generator sets, types A and E. Illustrated, 7x9, pp. 23, paper. Illustrated sectional catalog No. 189, describing "A B C" steel-plate fans for heating, ventilating and drying plants, etc. 7x9, pp. 82, paper. Illustrated sectional catalog No. 190, of "A B C" blowers for cupolas, forges, etc. 7x9, pp. 48, paper. Illustrated sectional catalog No. 200, describing "A B C" disc ventilating fans. 7x9, pp. 44, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Patented machines built to order. Interstate Machinery Co., Troy, N. Y.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Good tool or machine specialty wanted. Give full particulars. Automatic, 660, AM. M.

Light and fine machinery to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—To complete volume, AMERICAN MACHINIST of April 13, 1905. Will pay premium. Box 613, AMERICAN MACHINIST.

Punch press wanted. Bed opening about 22 in. Also No. 1 Universal miller. E. B. Abbott, 2912 Central avenue, S. E., Cleveland, Ohio.

Work wanted—We are thoroughly equipped for building fine automatic machinery. The G. N. McKibbin Manufacturing Co., South Norwalk, Conn.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear and Machine Co., 141 Oxford street, Philadelphia, Pa.

Draftsman — Combination mechanical and structural, with previous experience on large cranes; salary according to ability. Engineering Agency, Monadnock Block, Chicago.

Wanted—Worms, spirals and screws to cut. We are equipped with special machines for milling these parts. Get our prices on doing some of your difficult jobs. Parsons & Lane, Sodus, N. Y.

Wanted to manufacture in Canada: Sheet-metal stampings, hardware specialties, strip steel and wire forming. Ryall Screw and Specialty Company, 1570 St. Lawrence street, Montreal.

Designer and engineer on coal-handling plants and dredge work; some electrical experience required; give outline of experience and salary expected. Engineering Agency, Monadnock Block, Chicago.

Specialties—We make on contract, specialties for marine, automobile and general use, and do general machine-shop work on small brass goods. Lovell-McConnell Mfg. Co., Currier Bldg., opp. Pennsylvania Railroad Station, Newark, N. J.

A manufacturing concern having one of the most modern and complete plants in Ohio for the manufacture of brass and iron specialties, including steam goods, solicits orders for special work in quantity lots. Address N. L. H., 172 West Locust street, Columbus, Ohio.

We build special machinery, tools, etc., for responsible parties at prices which well demonstrate our modern practice and facilities. Estimates gratis. Send drawing for our lowest bid. New Haven Tool and Machine Specialty Co., 456 Broad St., Bridgeport, Conn.

Foreman — Large manufacturers of steam specialties, including valves, governors and pressure regulators, require competent working foreman for brass department; must understand brass finishing and valve work. State experience and salary expected. Engineering Agency, Monadnock Block, Chicago.

Tool catalog No. 22, 950 pages bound in cloth. Greatest small-tool catalog ever published. Will be sent post-paid on receipt of $1. Money paid for catalog refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton street, New York City.

Wanted—In quantity, from time to time, tapered steel tubing, seamless or brazed; in 30-inch lengths; large diameter, ¾ inch, tapering to small diameter, ½ inch; thickness of material, 1/32 of an inch; must be smooth inside and outside. Write for particulars to the Hall-Cane Umbrella Co., 906-7 Lippincott Building, Philadelphia.

For Sale.

For Sale—Excellent machine-shop building, with power, in Philadelphia; 60x90 feet, three stories, solid ground floor. Box 545, AM. M.

For Sale—Motor boat and bicycle repairing business; good opportunity for automobile business. M. S. Folkin, 224 Commercial St., Portland, Me.

For Sale—Second-hand Taylor water-tube boiler, used only two months; 2000 sq. ft. heating surface, 56 sq. ft. grate surface; sections easily transported. Box 701, AM. MACH.

For Sale—Machinery-manufacturing plant, including machinery, tools, jigs and good will. Doing a business of from $100,000 to $150,000 per year; can secure buildings with water power at very reasonable rent for term of years. Address J., Box 678, AMER. MACH.

For Sale—Complete electroplating outfit, including one 500-ampere dynamo, one 5 and one 10-horse-power motor 500-volt direct-current, two cedar and three iron tanks, together with nickel, brass, bronze and copper anodes, rheostats, switches, grinding and polishing lathes, carborundum, bull neck, canvass, felt and cotton wheels, power press, wood pulleys, shafting, hangers, belting and supplies. Jim Bowstead, Room 6, New Kiley Block, Marion, Indiana.

Business Opportunities.

Wanted—Thorough business party to take an interest in, or buy a going foundry, and small machine shop, now receiving orders for five tons castings daily. Address L., 1918 Morris avenue, Birmingham, Ala.

Wants.

Situation and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Engineer (English) seeks responsible position; 11 years' experience in H. M. Royal Navy; have had charge of erecting steam, electric and air-compressing machinery. Box 698, AMERICAN MACHINIST.

ILLINOIS.

Mechanical engineer, thorough experience in web printing presses, in shop and drafting room, executive ability, desires position. Box 697, AMERICAN MACHINIST.

MASSACHUSETTS.

Position as foundry foreman; change for promotion, Baltimore or Philadelphia; no agents. Box 694, AMERICAN MACHINIST.

MICHIGAN.

Mechanical draftsman and designer wishes to make a change. Familiar with automobile design; can design jigs and fixtures for manufacture of automobile parts; Detroit preferred. Box 703, AMERICAN MACHINIST.

Cost accountant—Young man, 29, five years' office experience, three years' shop experience as machinist in several different shops, desires position as cost accountant; competent to install and take charge of modern and efficient system; highest references. Peter Lowe, Adrian, Mich.

NEW JERSEY.

Engineer desires change; where now employed has charge of drafting room, shops, power plant, construction and maintenance and purchasing department; thorough practical training in all branches. Box 689, AM. M.

NEW YORK.

General foreman desires change; experience automobiles and machinery. Box 687, AM. M.

Mechanical draftsman and designer desires position in or near New York. Box 704, AMERICAN MACHINIST.

Responsible position in steam turbine manufacture; several years' experience. Box 631, AMERICAN MACHINIST.

First-class machinist and toolmaker, accustomed to fine, accurate work, automatic machinery, jigs, fixtures and experimental work. Box 695, AMERICAN MACHINIST.

General foreman, successful in producing first-class work at satisfactory cost, varied experience in high-grade machinery, master machinist, desires change. Box 675, AM. M.

Superintendent, master mechanic—Position wanted by American, 35 years; 18 years' practical experience; last 4 years electric manufacturing plant; salary, $2500 yearly. Box 690, AMERICAN MACHINIST.

Wanted—Position in publicity department of manufacturing establishment in Eastern territory; experienced in the preparation of copy and with the details of cut making and printing. Box 681, AMERICAN MACHINIST.

Mechanical engineer, technical graduate, 7 years' experience in pumping machinery and power house construction desires position as assistant engineer with contractor, consulting engineer or manufacturing company. Box 677, AMERICAN MACHINIST.

Expert tool designer and master mechanic desires change; age 36; high-grade and accurate work, jigs, fixtures, tools and automatic machinery for duplicate parts; A-1 references; position as superintendent preferred. Box 684, AMERICAN MACHINIST.

Competent superintendent would like to change; experienced toolmaker, tool designer, master mechanic and superintendent; 16 years' experience in the commercial manufacturing of small and medium interchangeable machinery; position preferred with some typewriter, adding machine or automobile manufacturing company; a cost reducer. Box 650, AMERICAN MACHINIST.

OHIO.

Situation wanted as superintendent by energetic young man, holding responsible position with concern in which he owns stock; desires change; first-class work produced at satisfactory cost. Box 693, AMERICAN MACHINIST.

PENNSYLVANIA.

Mechanical engineer and superintendent, 15 years' experience in general line, such as machine tools, cranes, hydraulic machinery, etc., wants to change. Can design and produce good work cheaply. Box 656, AM. MACH.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Wanted—Several competent all-around jobbing machinists. The Eastern Machinery Co., New Haven, Conn.

ILLINOIS.

Wanted—A thoroughly competent designer experienced in intricate and accurate automatic machinery. In replying, state nationality, age, salary required and give references. Box 705, AMERICAN MACHINIST.

Wanted, draftsmen—We want capable draftsmen of either electrical, mechanical or general experience. If you would like to change your position or its location, write and tell us about the character and extent of your work. Address, giving full particulars, to Western Electric Company, Dept. No. 29, Chicago.

MASSACHUSETTS.

Machinists—We are in need of first-class men with experience on steam engine work; good pay and steady work; no labor trouble. C. H. Brown Engine Co., Fitchburg, Mass.

Wanted—Cost clerk; experienced, capable man as assistant; must have thorough knowledge of cost finding in machinery line; pumping machinery preferred, though not essential; state age, experience and compensation expected. Box 680, AMERICAN MACHINIST.

Wanted—A few good, clean young men of mechanical turn of mind to work on fine tools. Several wanted in our micrometer department; those with experience preferred; steady employment guaranteed to the right men at good pay, according to experience and ability. Address, with references, The L. S. Starrett Co., Athol, Mass.

MINNESOTA.

Wanted—First-class machinists, moulders and patternmakers, also structural template makers and structural iron workers. We are daily increasing our business and will consider applications from competent mechanics in the above branches of our business. Address, with references, Minneapolis Steel and Machinery Co., Minneapolis, Minn.

NEW JERSEY.

Wanted—Mechanical electrical draftsmen; only first-class men need apply. Box 508, AMERICAN MACHINIST.

Wanted—Metal patternmaker to make pattern plates for moulding machine. Apply either in person or by letter to Jenkins Mfg. Co., Bloomfield, N. J.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

Wanted—High-class man for superintendent of plant employing 100 men manufacturing metal specialties for automobile trade; must have executive ability of the highest order and be capable of organizing works to best advantage. Box 688, AMERICAN MACHINIST.

Foreman to take entire charge of shop manufacturing speed-meters in large lots. To a man who is now employed in similar work, and making a success, we can offer a permanent position at a good salary. State present position and pay expected. All communications treated confidentially. Motor Car Specialty Co., Trenton, N. J.

Wanted—Office manager by large portland cement company located near Easton, Pa. Must be first-class accountant and have had considerable practical experience with manufacturing books, and be able to handle office employees to best advantage; first-class opportunity for able man; good salary paid. Give full particulars as to experience. Address, "Portland Cement," 674, AMER. MACH.

NEW YORK.

Wanted—Two first-class experienced wood patternmakers. Apply by letter to Box 696, AMERICAN MACHINIST.

Wanted—A draftsman familiar with gas-engine designs; must be up-to-date. First-class place for right man. Box 691, AM. M.

Wanted—Experienced draftsmen, toolmakers and machinists. Give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

Diemaker and machinist to make dies and run automatic machines in a factory making builders' hardware. Apply to J. H. Sayres, 452 Classon avenue, Brooklyn.

Ingersoll-Rand Co., Painted Post, N. Y., is rapidly increasing force and invites applications from machinists for all branches of the trade. Excellent opportunity is offered energetic, capable young men. Box 641, AM. M.

Wanted—A foreman to take charge of die room containing 25 to 30 diemakers, making punching, blanking and drawing dies for light sheet steel and brass work. Reply, stating

age, experience and wages expected, to Box 699 AMERICAN MACHINIST.

Draftsmen Wanted—First-class electrical mechanical draftsmen; only practical, experienced men need apply. State age, experience, reference, and salary expected. Permanent position if satisfactory. Address Box 702, AMERICAN MACHINIST.

We are permanently increasing our capacity and require the services of 20 mechanical draftsmen for detail work. Attractive positions to suitable men. Location in New York City. Address, stating age, experience and salary expected, Box 627, AMER. MACHINIST.

Wanted—Machinist with road experience as salesman, calling on all iron-working plants. Knowledge of turrets, automatics and threading machines, cutting tools and dies essential. State age, experience, salary expected and references. Box 618, AM. MACH.

Wanted—For a large manufacturing establishment, a general foreman to take charge of tool room containing 170 toolmakers, with five assistant foremen; engaged in making jigs and fixtures, ornamental and drop-forge die work, and a general line of small cutters, reamers, taps, etc.; also miscellaneous machine repairs. An excellent opportunity for the right man. Reply, stating age, experience and wages expected, to Box 700, AM. MACH.

NORTH CAROLINA.

Wanted—An up-to-date all-around machinist for general repair work. Write, stating age, experience and wages expected. Carolina Machine Co., Fayetteville, N. C.

OHIO.

Several first-class draftsmen on detail and assembly drawings; state age, experience and salary. Box 609, AMERICAN MACHINIST.

Three or four competent mechanical draftsmen. In replying, give full information, including rate expected. Box 686, AM. MACH.

The National Metal Trades Association can place a few first-class wood patternmakers, toolmakers and all-around machinists. Highest wages and steady employment guaranteed. Address, with references, Robert Wuest, Secretary, 1416 Union Trust Bldg., Cincinnati, O.

PENNSYLVANIA.

Wanted—First-class draftsman on mill construction and equipment, technical man preferred. Box 578, AMERICAN MACHINIST.

Wanted—Thoroughly experienced erecting machinists, accustomed to steam engine or compressor work. The Blaisdell Machinery Co., Bradford, Pa.

Wanted—First-class instrument and toolmakers; also large machine-tool operators. Address Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

Wanted—A first-class man as general foreman of our brass department on brass globe, angle and gate valves, and a general line of steam goods. Factory located in western Pennsylvania. To the right party we have a good position to offer. State age and experience. Address Box 692, AMER. MACHINIST.

Wanted, machinists—We are enlarging our shop and can use a few first-class bench and floor hands. None but steady, reliable men looking for permanent positions need apply. Shop new and equipped with best tools. This city has fine schools, pure drinking water, etc.; a good place for men wishing to establish homes. Men with experience on high-grade machine-tool work preferred. Apply to Gisholt Machine Co., Warren, Pa.

The Monotype Company maintains a free school for training young machinists to operate its type casting and composing machines. The demand for monotype operators is so great that it receives more applications for places in its school than can be filled. In making selections these qualifications carry most weight: character common sense, experience with automatic machinery, (or) printing-office experience, or type-foundry experience. Full particulars will be furnished to inquirers who furnish full particulars about themselves. Lanston Monotype Machine Co., 1231 Callowhill St., Philadelphia, Pa.

RHODE ISLAND.

Toolmakers wanted—First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Pierce Mfg. Co., Woonsocket, R. I.

WEST VIRGINIA.

Wanted—Accurate machinist on marine engine work. Ward Engineering Works, Charleston, W. Va.

WISCONSIN.

As the result of doubling its new West Allis plant, Allis-Chalmers Co., of Milwaukee, needs more patternmakers, machinists and moulders.

Wanted—A strictly high-grade tool-room foreman for small machine shop doing delicate work; must be employed at this time; state salary wanted and give experience in detail. Address W. J. Carney, 451 19th avenue, Milwaukee, Wis.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

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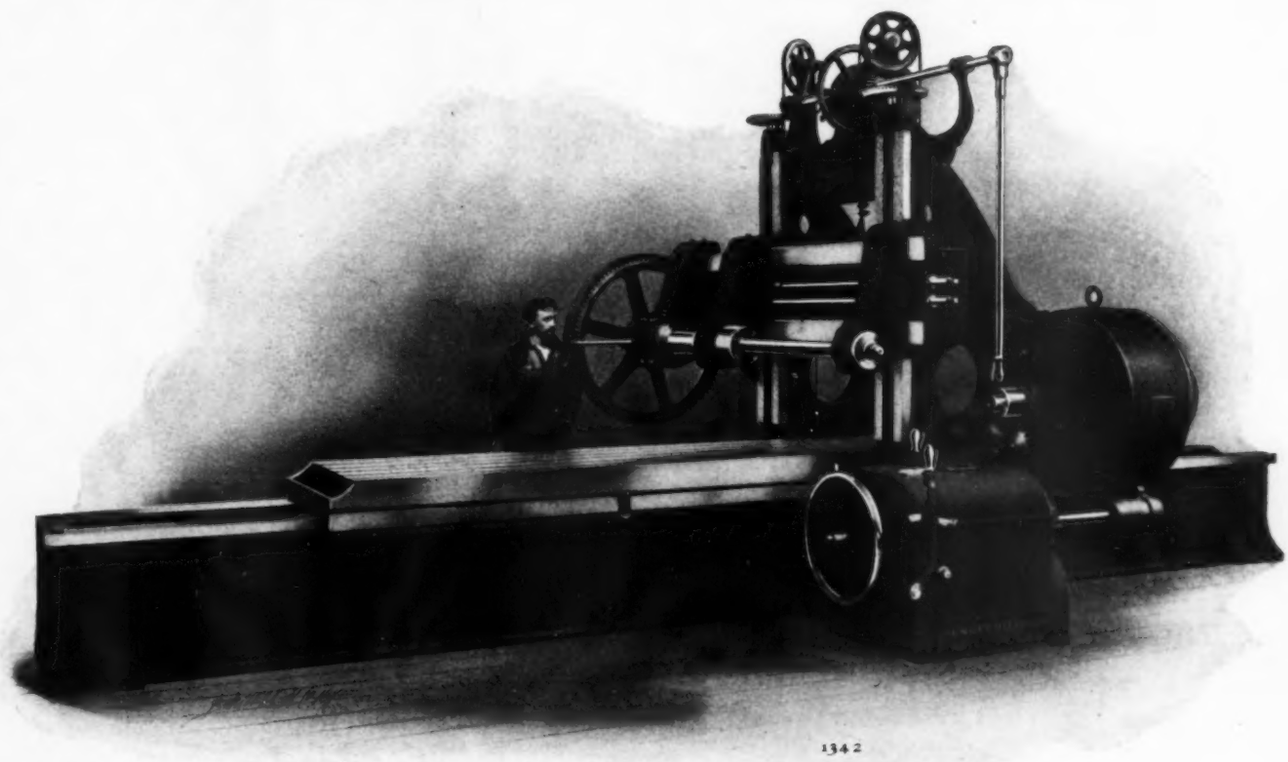

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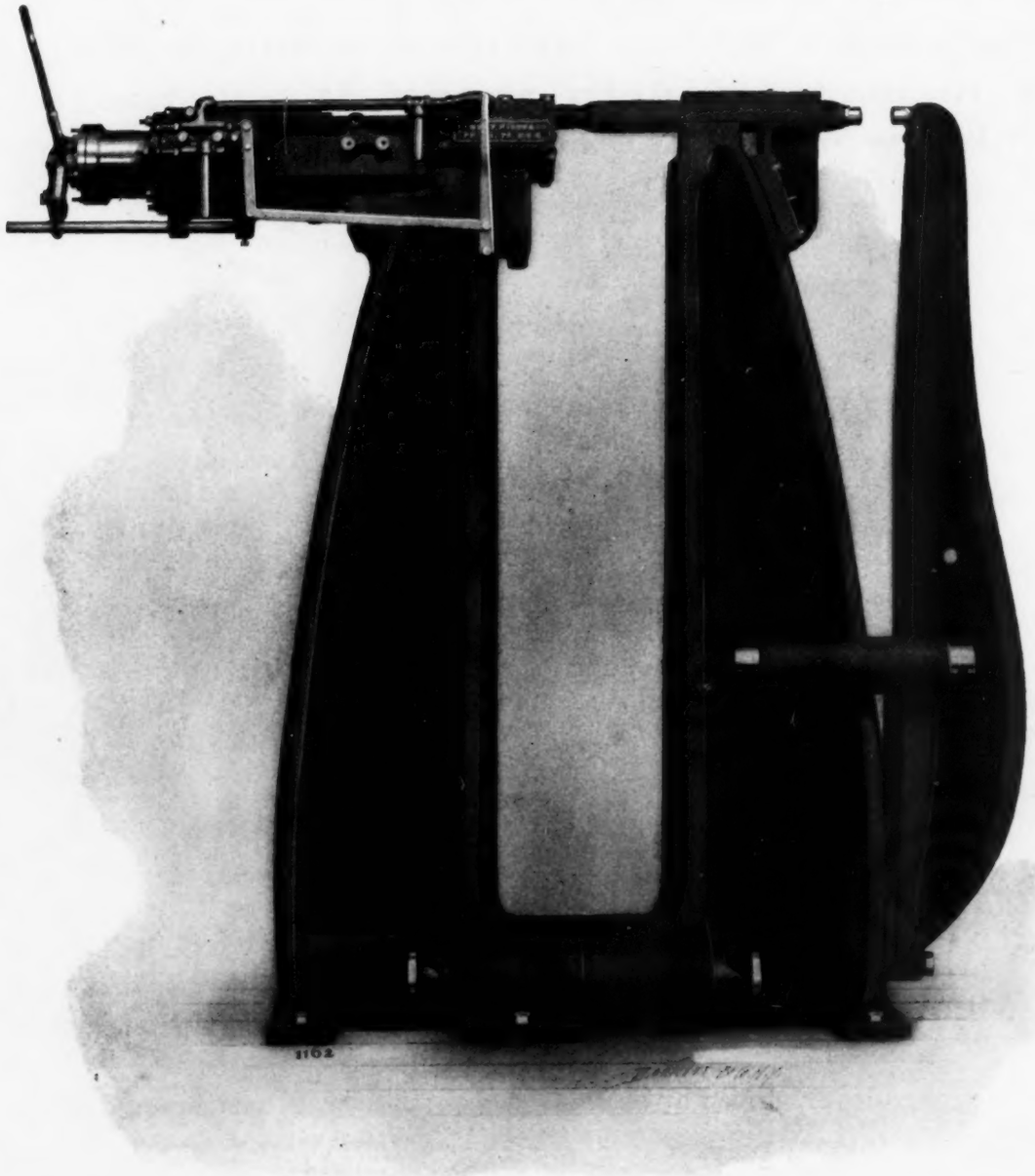

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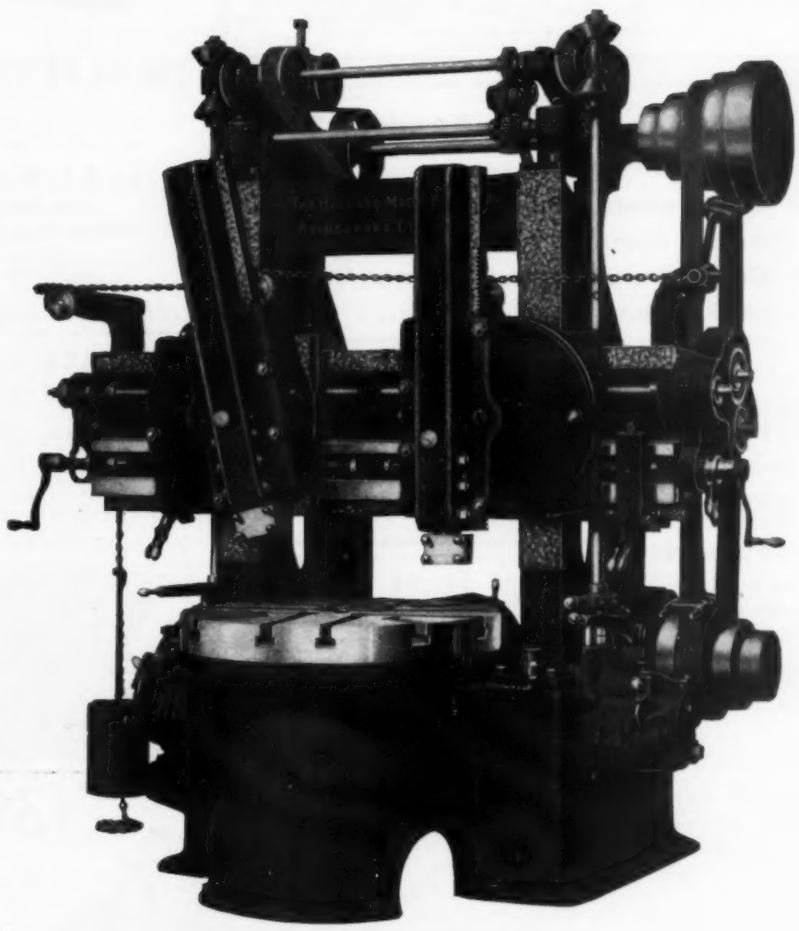

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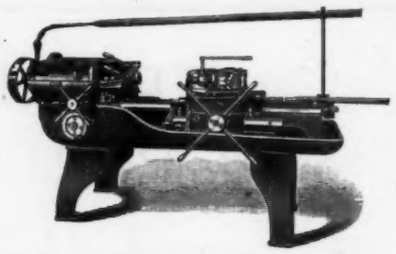

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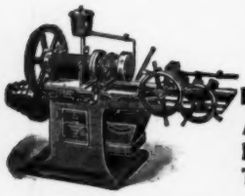

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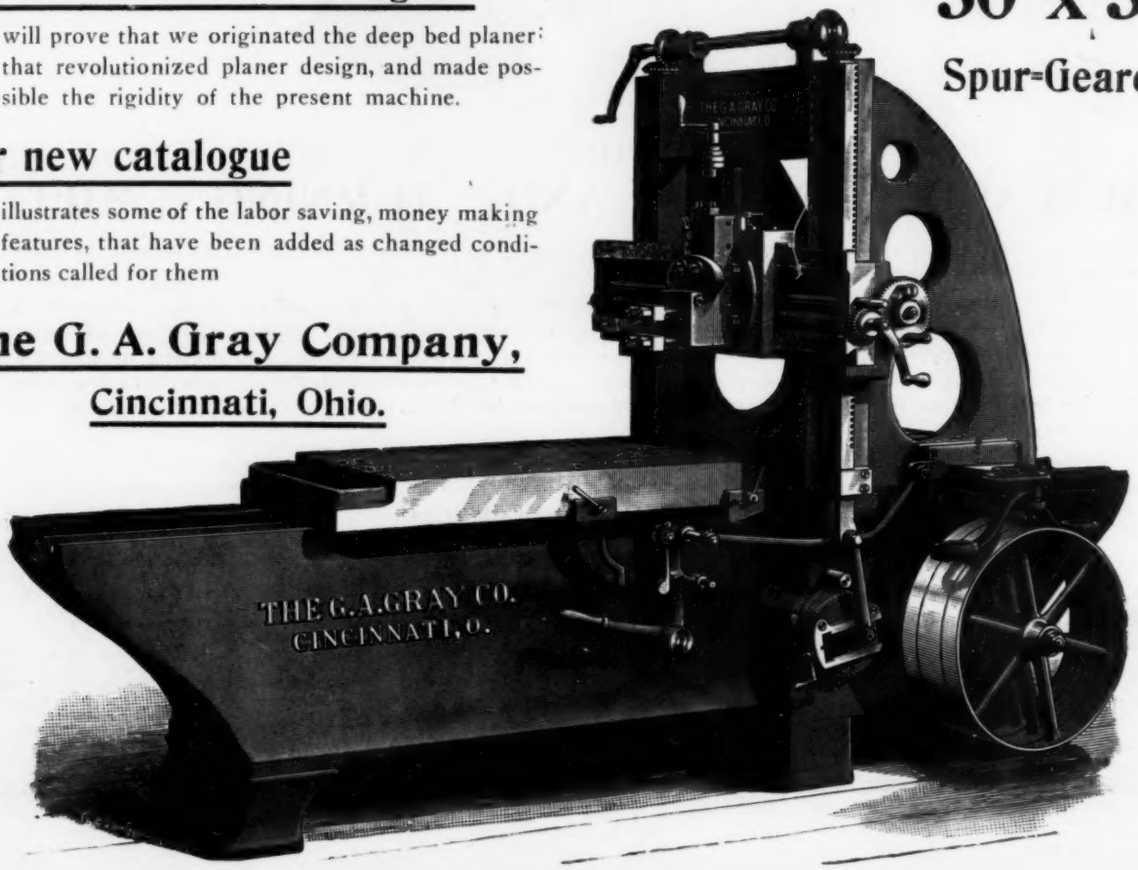


High-Speed Turret Lathe.

The accompanying engravings illustrate a new machine manufactured by Prentice Brothers Company, of Worcester, Mass., and known as their high-speed turret lathe. This tool is not designed for handling bar stock, but is built specially for rapidly machining cast-iron work, such as gears, pulleys, cones and similar parts up to 15 inches diameter. The half-tones, Figs. 1 and 2, give an excellent idea of the machine as a whole, and the line drawings

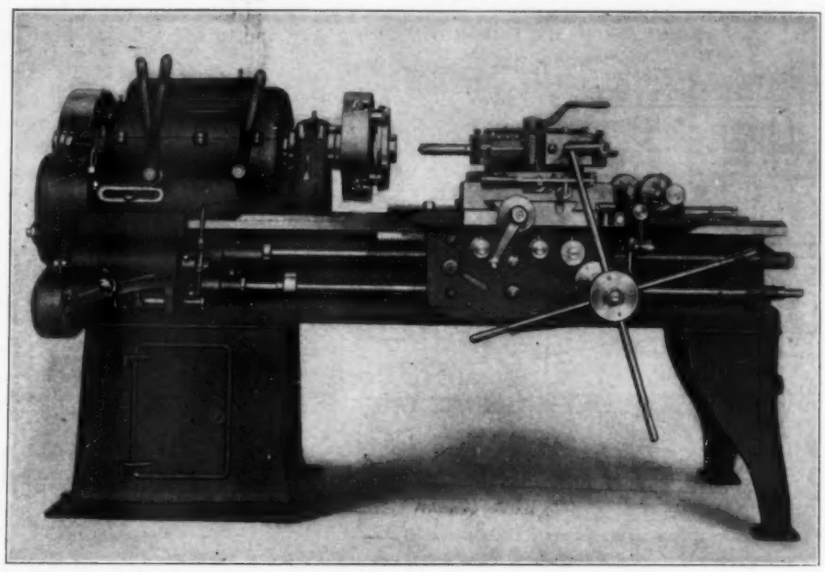


FIG. 1. HIGH-SPEED TURRET LATHE.

illustrate various interesting features of construction.

It will be seen from the general views that the turret is arranged for cross traverse; and on account of the wide movement given the tools it will be evident that in order to maintain a proper cutting speed the spindle speed must be varied considerably as the diameter of the work increases or decreases. This regulation of the spindle and cutting speeds is secured through the friction-geared high speed head which is conveniently controlled by means of the levers shown at the front of the case.

The geared head is driven by a 4-inch belt running over a plain pulley, and with a single speed countershaft eight spindle speeds are obtained. The mechanism will be understood from the various sections in Fig. 3, where the three controlling levers are represented at *A*, *B* and *C*, and the driving shaft at *D*. The latter, which of course runs at a constant speed, carries two friction clutches *E* and *F*, either of which may be operated by lever *A* which is connected as shown with the sliding cone lying between the two frictions. Between the spindle and the pulley shaft is located the shaft *G* which carries two gears *H* and *I* of different diameters, meshing with corresponding gears on the driving shaft, and also with gears which are secured to the hubs of friction members *J* and *K*. These frictions run loosely upon a quill which is mounted loosely on the spindle, and which carries the friction member *L* at one end. The friction rings *M* and *N* are keyed to the quill, while friction ring *O* is keyed to the spindle. The four high speeds are obtained as follows: With frictions *F*, *N* and *O* driving directly; with frictions *E*, *M* and *O* driving directly; with frictions *F*, *M* and *O* driving through the intermediate shaft, and with *E*, *N* and *O* also driving through the intermediate shaft. The back gears and the spindle driving gear *P* run constantly while the sliding cone or spool *Q* is engaged with either friction *E* or *F*. By engaging the friction spool and clutch *R*, which is feathered to the spindle, with driving gear *P* the back-gear speeds are obtained. With a two-speed counter furnished when required the number of speeds may be increased to sixteen.

To enable the operator to make changes in the feed as the piece of work is passing through its different operations the machine is equipped with positive geared feed mechanism conveniently arranged at the end of the bed. The mechanism is the well known quick-change gear of this company as adapted to their regular line of engine lathes and is arranged to give 44 different rates of feed.

The turret slide, as indicated in the general view, has a substantial bearing on the bed and is so constructed as to permit of a 7½-inch cross traverse of the turret. Fig. 4 gives plan, end view and sections of the turret and slide, and shows clearly the operating mechanism. On the bottom of the turret which is of the hexagon type is formed a large bevel gear *A* which has 168 teeth and which meshes with a bevel pinion *B* of 24 teeth which is splined to the shaft *C* so that it may slide in and out on the shaft as the turret is fed crosswise. As the ratio between these gears is 7 to 1, it will be seen, that for each 1/6 revolution of the turret, the shaft *C* will make 1 1/6 turns, which movement is transmitted through the miter gears *D* and *E*, shaft *F*, spur gears *G* and *H* and shaft *I* to the stop drum *J*, giving the drum 1 1/6 turns to each 1/6 revolution of the turret. This will bring the proper stop screw into position for each of the tools in the turret. The large diameter of the bevel gear on the turret is a necessity on account of the required cross traverse.

The turret is so designed that if the operator desires to use two or more longitudinal stops for one tool, the stop drum can be unlocked by simply sliding the splined collar *K* out of mesh with the drum, thus leaving the drum free to be turned at will regardless of the turret.

In connecting the drum with the turret again, it can be locked only in its proper position as regards the turret, as there is only one hole in the drum for the pin in the collar to engage in. After the longitudinal stop has automatically tripped the feed it is advisable to hold the carriage forward against the stop during a

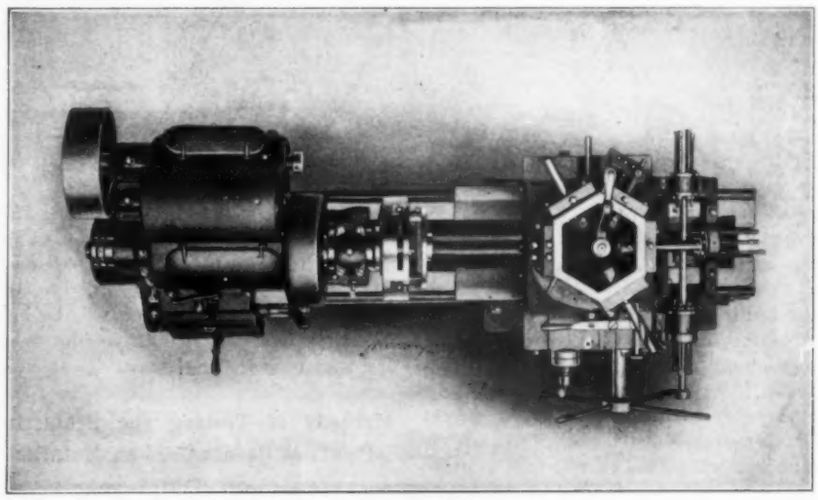


FIG. 2. HIGH-SPEED TURRET LATHE.

few rotations of the work, so as to form a perfect shoulder. This is done by pressure upon the pilot wheel, which causes the carriage to be held positively between the dog *L* and the bushing *M* on shaft *I*.

The cross-feed stops, of which there are twelve, six at the front of the turret and six at the rear, do not operate automatically with the turret, but will, however, automatically trip the cross feed which is operated by a friction device arranged on the cross-feed screw, and consisting of two friction disks with fiber washers, one splined to the screw, the other meshing with the cross-feed gear. These twelve cross-feed stops and six longitudinal stops

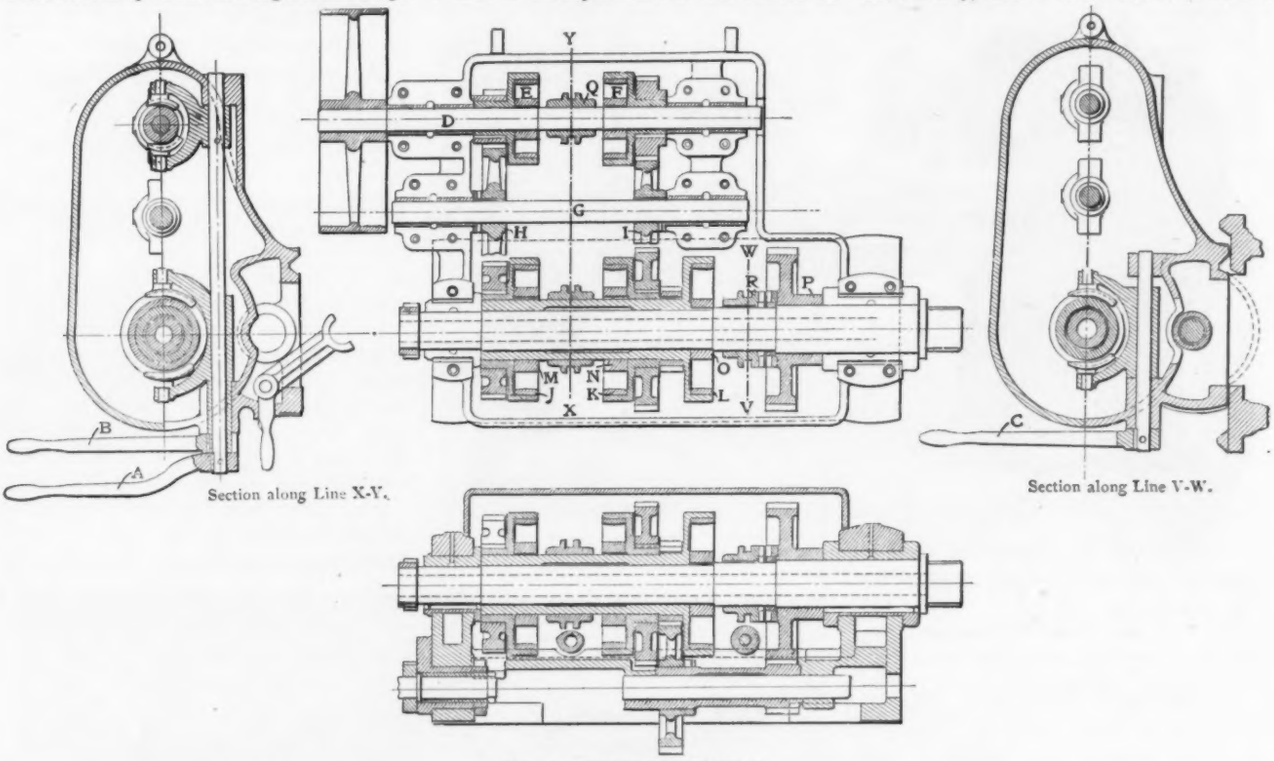


FIG. 3. TURRET LATHE HEAD.

form means of controlling a great variety of operations, and so permit a wide range of work to be handled with facility.

The apron is of heavy construction and is so geared as to enable the operator to start, stop, and reverse the feeds, either longitudinal or cross, at will. The longitudinal feeds are tripped automatically by a device shown in Figs. 4, 5 and 6. As the turret carriage feeds along on the ways and one of the stop screws in drum *J* engages with dog *L* (Fig. 4) inside of the bed, the drum is held fast while the carriage continues to feed causing shaft *N* (Figs. 5 and 6) to rock slightly, till the latch lever *O* (Fig. 6) releases the dog *P* on spring stud *Q* at the front of the apron. The dog upon being released springs down till it meets the stop *R* on the spring casing and through lever *S* and arm *T* operates the clutch *U* on the feed rod, and disengages it from the bevel pinion *V* or *W* thus stopping the feed. In order to reverse the feeds, it is only necessary to turn the dog *P* 45 degrees so as to permit it to pass by the stop *R*. This drop will permit the clutch in the apron to engage the opposite bevel pinion. This reverses both the longitudinal and the cross feeds.

Besides the feed rod the machine is also provided with a lead screw which permits any of the standard threads to be cut, and may also be used for carrying very coarse feeds. In order to prevent engagement of the open-and-shut nut while the rod feed is in operation a simple locking device has been adopted. When the clutch on the feed rod is engaged with either bevel pinion, a rod *a* (Fig. 6) locked to the clutch, throws a link *b* into a T-shaped slot in the bottom of the feed-nut *c*. It will be seen that it is impossible now to engage the nut as the pin in the link holds it locked except when the clutch is in mid position. Also, it is obvious that the clutch will be held in central position as long as the open-and-shut nut is engaged with its screw.

Methods of Testing the Protective Power of Paints Used on Metallic Structures.

E. Ebert, in a report to the International Association for Testing Materials, has, among other things, the following to say with reference to the protection of iron surfaces against rust and other prejudicial chemical influences.

The view previously entertained by many manufacturers that the formation of rust tended to promote further oxidation by chemical means, and that, therefore, preparations containing oxide of iron exercised a prejudicial effect, has, as the result of extended experiments, been fully and completely disproved.

Experiments with actual iron and rust have proved that if it is thoroughly ground and rubbed up with linseed-oil varnish it produces no prejudicial effect upon iron to which it is applied. If, however, rust has formed upon iron, it acts very much like a sponge in virtue of its porosity, collects the water, retains it, and so considerably promotes the further rusting of the metal.

This phenomenon has been long familiar to experienced constructors, and is the reason why they always take care to build in such a way, and to select the color of the paint employed, so that any formation of rust can be easily recognized the instant that it takes place. . . . . According to the above mentioned experiments, there can be no objection, particularly where the color does not matter, as in the case of body coats, to leave the pigments out altogether.

The information which has been supplied to us from France, Germany, Russia and other countries does not lead to the conclusion that there is any general agreement as to any particular anti-rust composition being superior to another. On the contrary the views differ very considerably. Agreement, however, prevails that the testing of such compositions prior to their use would not lead to the results desired by the Institute.

None of the anti-rust preparations with so-called acid-proof components have proved, according to my experience, adequately to resist the action of the acids of sulphur which are contained in the smoke of locomotives.

The durability of the layer of preparation in contact with the metal depends upon the first coating of body color; it is in addition largely determined by observing the principle that it should only be applied in warm, dry weather, and only to surfaces which are themselves dry. Unfortunately, the preparation of the body coat is not always carried out with the degree of attention that should be bestowed upon it, but is often done by workmen as incapable as unskilled labor, particularly when the end of the contract period is approaching. In addition, the cleaning of the surface of the iron is often not done properly, with the result that the body coats do not produce the proper effect. In a short time they fall off altogether.

Though the importance of cleaning has been pointed out, it does not, however, follow that the iron surfaces must be absolutely bright. Experiments which were carried out in order to ascertain what was the effect of cleaning have proved that it is fully sufficient in order to free the iron from all impurities to go over it with a wire brush or scraper, or, if need be, to employ a hammer to knock off any adhering scale. The layer of oxide or rust which remains after this treatment does no harm, and is in fact serviceable, as the preparation adheres better to it than it would to a brightly polished iron surface. The management of a certain railway line for many years maintained that the iron before being treated with the compositions should be cleaned bright in dilute hydrochloric acid, then inserted into lime water, washed in hot water, warmed up to a high temperature, and after the very rapid drying which then results, painted over with linseed-oil varnish. This may be suitable to work on a large scale, but it is not so appropriate for small work. In such cases there is always danger that the hydrochloric acid which has penetrated into the interstices of the iron will

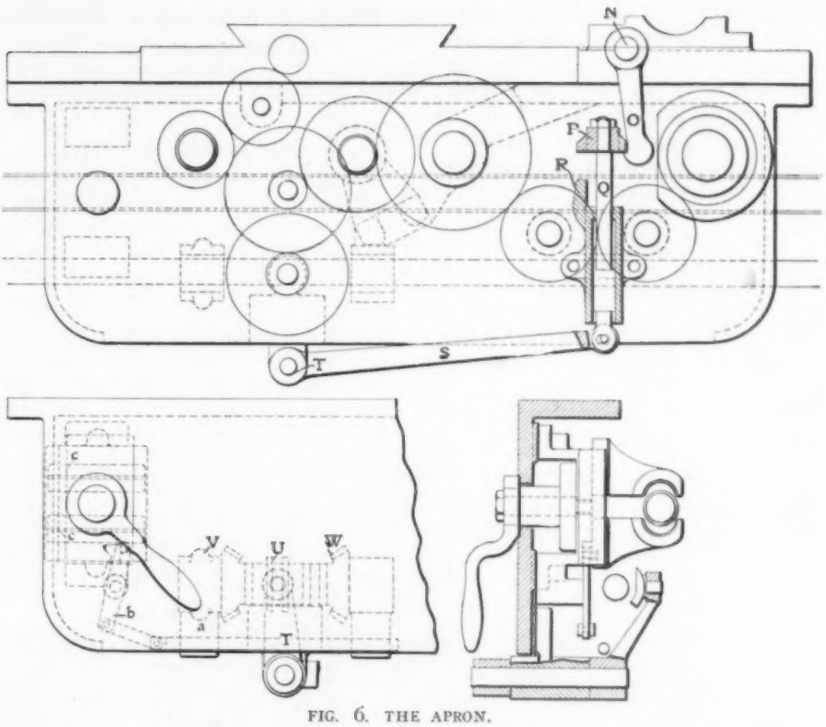


FIG. 6. THE APRON.

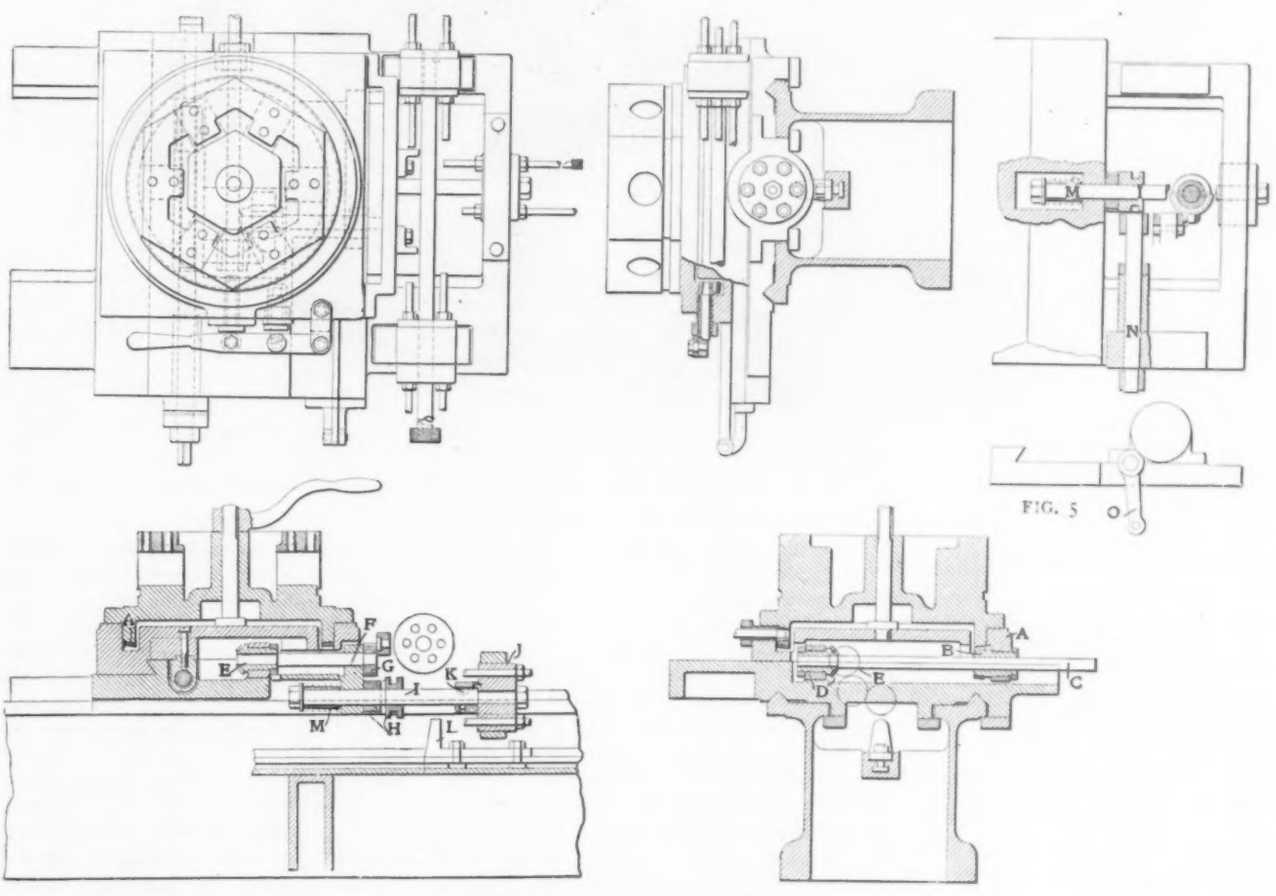


FIG. 5

FIG. 4. TURRET AND SLIDE.

remain there and produce a deleterious effect. Experiments have shown that the methods adopted by the Bavarian State Railways of using a body coat of linseed-oil varnish without pigment has not caused any trouble. The conclusion is that the durability of the anti-rust preparation depends upon the quality of the linseed-oil employed, and accordingly the greatest attention has been devoted to the preparation of the latter.

Belgium's exports of firearms in 1905 amounted to 2,682,111, an increase over the previous year by over 200,000, writes Consul J.C.McNally, of Liège. The Russian demand, especially for pistols, helped make it a banner year for the Belgian fire-arm trade. While the introduction of these arms into Russia has been prohibited, the demands have not diminished, other markets having taken on a greater activity. The manufacture of steel gun barrels is increasing, while those of the iron and "damas" variety are notably decreasing.

The last means, of course, that users of shoulder guns are gradually finding out what mechanics have long known, i.e., that a gun barrel made of a suitable quality of steel is far superior to the "damas" or twist barrel.

The Gleason Automatic Bevel-Gear Generating Planer.

EDITORIAL CORRESPONDENCE.

A peculiar interest attaches to bevel gear generating machines, and the latest addition to the list of brilliant designs of machines of this class by the Gleason Works, of Rochester, N. Y., will be found to sustain this interest.

The general appearance of the machine is well shown by the three half-tones, of which Fig. 1 shows the manner in which the tools attach the work, Fig. 2 shows the manner in which the tools are driven, while Fig. 3 shows the method of obtaining the generating motion. The method of attack is by a pair of tools which act on opposite sides of the tooth being planed, both of these sides being planed at the same action which thus completes a tooth. The inner or cutting sides of these tools represent the sides of a crown-gear tooth of the same pitch as the tooth being planed, the tools reciprocating rapidly lengthwise of the tooth at the same time that blank and tools move past one another in the relation of a crown gear and bevel-gear tooth. The reciprocation of the tools is on converging lines, the angle between which is such that if those on which the cutting edges move were prolonged they would meet at the cone center of the machine.

DESCRIPTION OF THE MACHINE.

Assuming the basic principle on which all bevel-gear generating machines act to be generally understood, the means by which this principle and the movements which represent it are incorporated in the present machine will be understood from the following description.

Referring to Fig. 4, the cone center of the machine is at *a*, the blank at *b* and one of the cutting tools at *c*. The entire tool reciprocating mechanism is mounted on a swivel plate or turret *d* better shown in Fig. 1. This plate swivels about the cone center of the machine, the line of reciprocation of the tools *a f* being thus adjustable to the angle of the gear to be cut. The swinging of the tool slides to give the gear-generating motion is about the horizontal line *a g* which also passes through the cone center and is seen end on at *a*, Figs. 5 and 6, which also show how the slides converge. The oscillation of the blank and tool in the generating movement are accomplished by the yoke *h*, Fig. 4, which surrounds one-half of the machine, its center line of motion being the center of the work mandrel. A feather at the right-hand end of the yoke engages the work

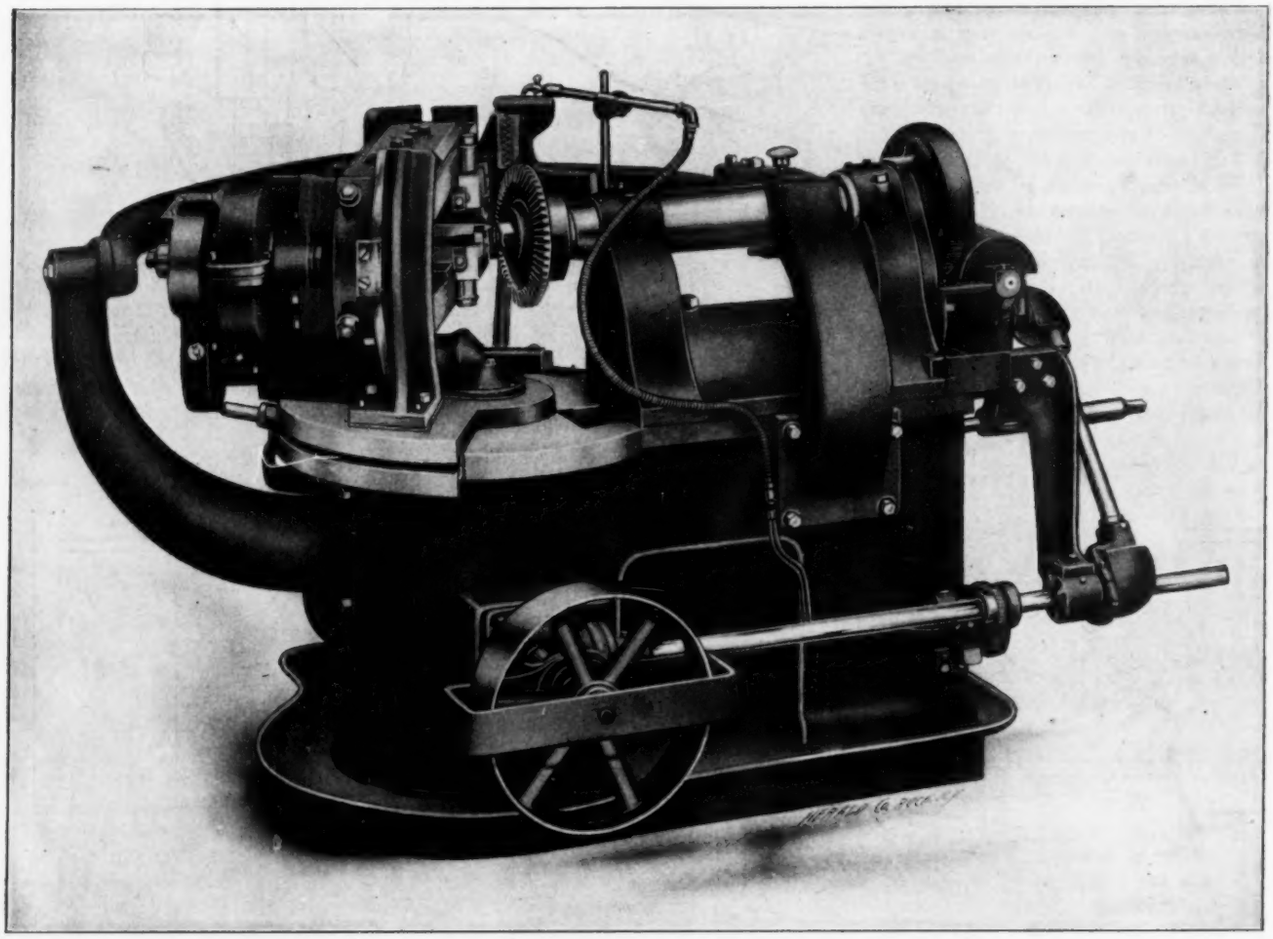


FIG. 1. THE GLEASON BEVEL-GEAR GENERATING PLANER.

mandrel, which thus oscillates with the yoke. A toothed segment *i* is attached to the yoke, an assortment of segments being provided. These are all of the same pitch of tooth, but vary in the angle *f a j*. A series of bolt-holes for attaching the segments to the yoke will be seen in Fig. 3 where also the segment in use is shown. The segment having the angle of the gear to be cut being selected and attached to the yoke at the proper point such that its pitch line is a prolongation of that of the gear to be cut as shown in Fig. 4, a point as to vary the speed of the motion at different parts of its length. Near the pitch line where the cut is comparatively heavy the movement is slow, and as the ends of the tooth where the cut is lighter are approached the speed increases. The movement is, moreover, such that a roughing and a finishing cut are taken from each tooth. The tools enter the tooth with the yoke horizontal. The first movement of the yoke then takes a roughing cut from one end of the tooth, the return of the yoke to the horizontal position serving as cheek piece *c*. The cheek pieces are swiveled about the center line *a* and the guide bars may thus be adjusted to any angle to suit the tooth angle of the gear to be cut, this adjustment being made by the turnbuckle *f*. On the same axis *a* is an oscillating shaft carrying a spur pinion clearly shown in Fig. 2, but omitted from Fig. 5. Each tool slide carries a rack extension, also clearly shown in Fig. 2, the racks engaging the pinion on the top and bottom sides respectively. The oscillation of the pinion thus reciprocates both

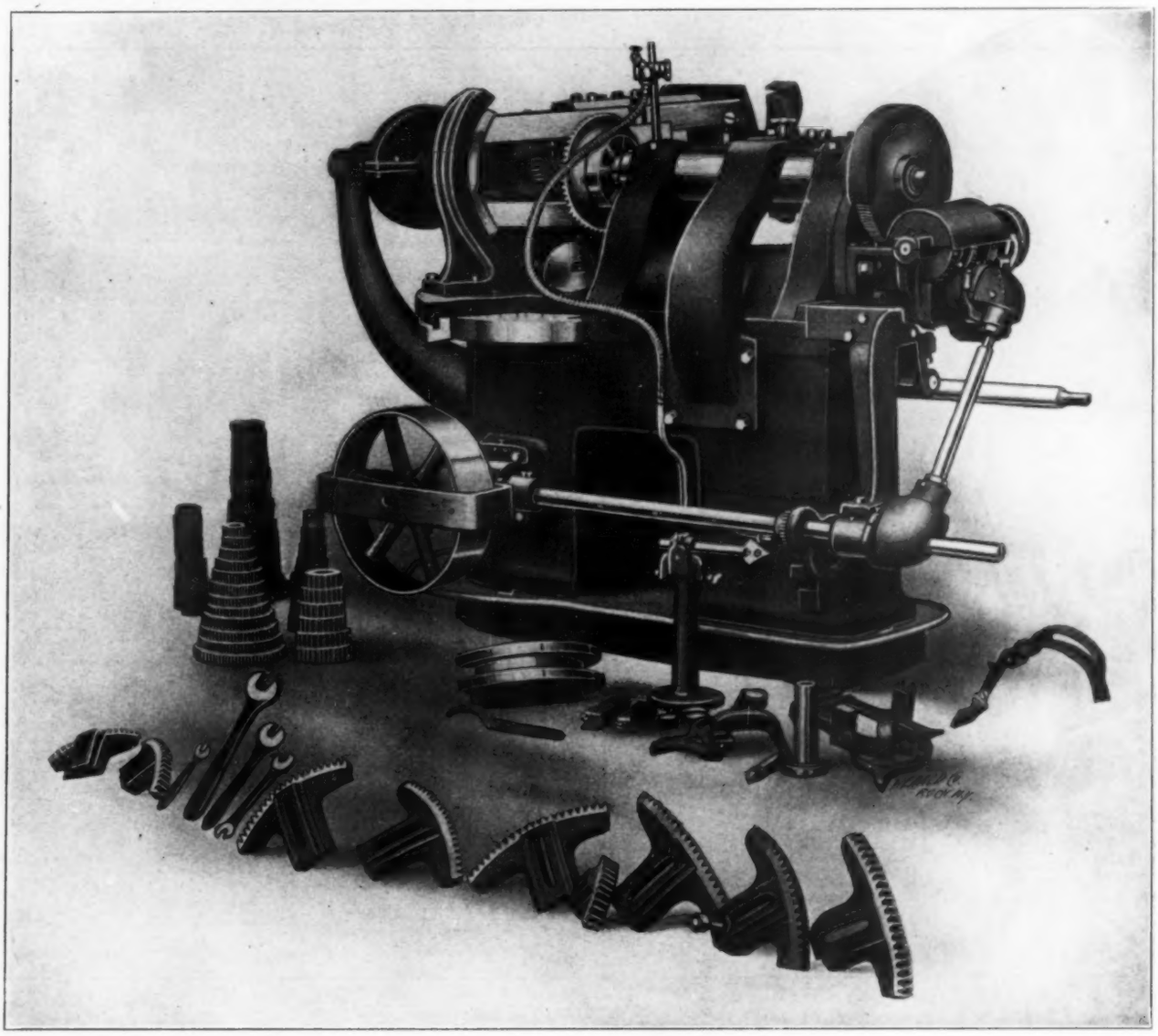


FIG. 2. THE GLEASON BEVEL-GEAR GENERATING PLANER.

is obtained from which to take off the generating motion of the tools. This is done by the crown-gear segment *k* which is bolted to the end of the swinging frame which carries the tool slides.

The swinging of the yoke is accomplished by the vertical connecting rod descending from it, as shown in Fig. 3 and at *g* in Fig. 5. This rod is driven by the radius arm to which it is adjustably connected to vary the stroke and by the cam behind the arm, the cam being so laid out a finishing cut for that end, when the movement of the yoke to the opposite end of its stroke and its return to the horizontal position do the same for the other end of the tooth.

RECIPROCATION OF THE TOOLS.

The reciprocation of the tools on their guide bars is accomplished very neatly, as shown in Figs. 2 and 5. The lower guide bar *b*, Fig. 5, is attached to a cheek piece *c* and the upper bar *d* to a corresponding tools but alternately in direction. Since the adjustment of the guide bars for the tooth angle is about the center of the pinion, the engagement of the racks is obviously correct for all angular positions of the guide bars. The driving motion for the tools comes up through the center of the turret as indicated by the bevel-gear covers shown in all the half-tones, and is then carried horizontally outward to connecting gears as indicated in Fig. 1 by their covers, and partially shown in Fig.

6, where *b c* are change gears for determining the number of strokes of the tool per minute. The oscillation of the tool-slide driving pinion is by the adjustable crank and rack shown in Fig. 6, and by a pinion on the outer end of the tool-slide driving-pinion shaft of which the cover is shown. The adjustment of the crank determines, of course, the length of stroke of the tools.

THE ADJUSTMENTS OF THE MACHINE.

The operation of the machine will be further understood by going over the leading adjustments. The base of the turret will be seen from Fig. 6 to be graduated with a zero mark at *d*. Since the tool must plane to the bottom of the spaces, the adjustment of the turret is to the root cone angle of the gear, the adjustment of the segments back to the pitch cone angle being by the short arc *s* Fig. 4, the adjustment here being made to read the difference between the root angle and the pitch cone angle. The adjustment of the tool guide bars to the tooth angle is by the turnbuckle *f* and graduated arcs Fig. 5, as already explained. The adjustment of the blank to accommodate varying lengths of hub and to bring the cone center of the blank into the cone center of the machine is by sliding the work head lengthwise of the machine by a crank handle *m* Fig. 1, binding bolts *n o* securing it in position. When making this adjustment binding bolt *p*, which secures the swinging yoke to the spindle, must obviously be loosened. The previously described adjustments being first made, the gage *a* shown in two views in Fig. 7 is brought into use. A vernier at the bottom is first set for the required depth of tooth when the gage is placed on the slide bars and applied to the extreme outer diameter of the blank. When the head of the machine is properly set to bring the cone centers of blank and machine to coincide, the vertical pointer reads zero and the head is adjusted until this reading is obtained. For the adjustment of the tools a gage *a* shown in Fig. 8 is provided which also is applied to the slide bars and which indicates the correct setting of the tool as shown in the end view. To enable any damage to these gages to be discovered, master gages for testing their accuracy are provided.

The machine has been described as applied to the completion of a gear which has already been stocked out. Provision is, however, made for doing this stocking out by suspending the oscillation of the yoke. The description might be extended in length by including other features, especially the feed and the index mechanism, but these, being details built into the general design, are omitted. It should, however, be added that both are automatic and positive, and that this statement applies to the machine when used for stocking out as well as for finishing.

F. A. H.

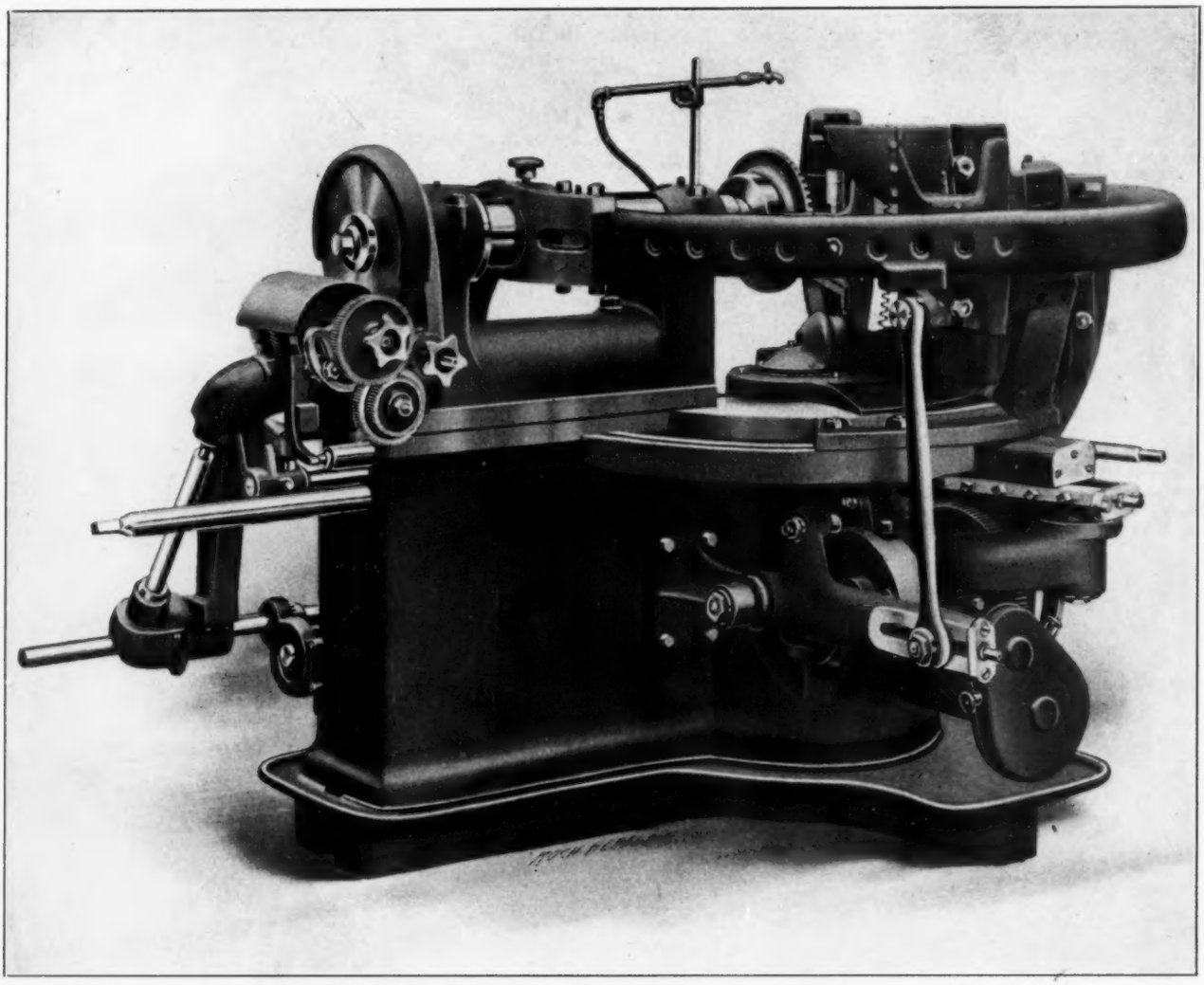


FIG. 3. THE GLEASON BEVEL-GEAR GENERATING PLANER.

Zebra-traction is something rather uncommon in the railway line. It is proposed to use domesticated zebras in Zanzibar for hauling the street cars, an order for 40 of the animals having been placed with the proprietor of a 40,000-acre zebra farm in Uganda, Africa. The zebra is superior to the mule in strength and endurance of the climate, and attacks of the tzetze fly.

Trade Journalism—The "Write-Up."

At page 688 we commented briefly upon an article by James H. Collins in the *Saturday Evening Post.* The second instalment having been now published, the two are reviewed by our contemporary, *Engineering Record,* in a somewhat different vein. Our contemporary says:

Some of the readers of this paper have doubtless been interested in a couple of articles on the subject of trade journalism, recently published by an elderly Philadelphia contemporary. It is really not the part of business courtesy for a fellow-publisher, even if he has inherited the wig of Benjamin Franklin, to give away to the general public so much inside information concerning the delightfully soft snap enjoyed by those engaged in this business. It is all right, of course, to indicate that trade journalism is able to keep the wolf away from the door and even to furnish a dollar table d'hote on an occasional Saturday night when subscribers have paid up in real money instead of compliments on the character of the paper; but it is a cruel blow from a brother's hand to show what a very easy thing it is to run such a journal. The author of the articles points out that people without the strength or inclination to take part in the arduous duties of daily newspaper work will find in trade

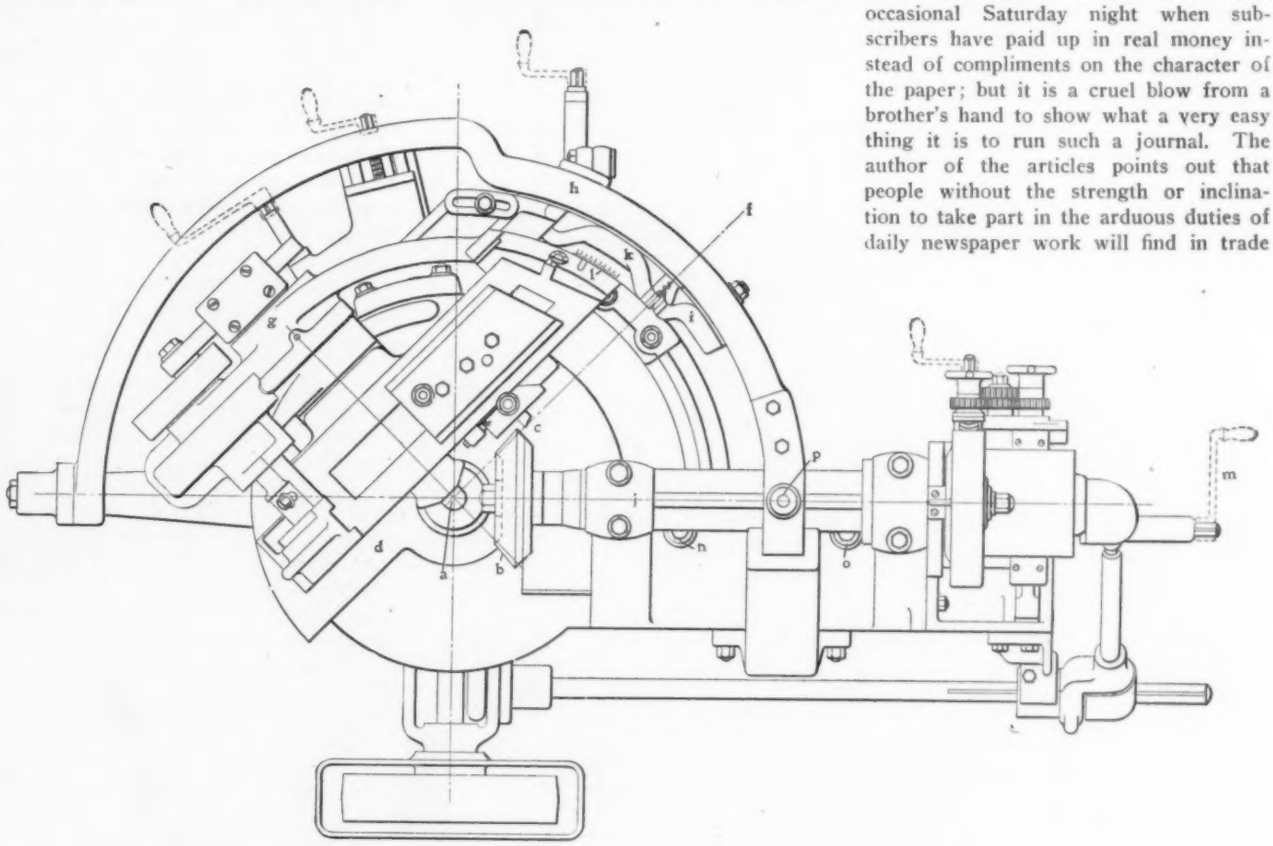


FIG. 4. PLAN OF MACHINE.

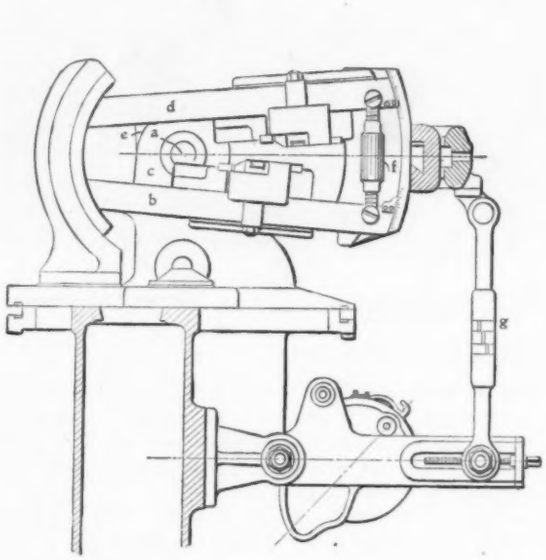


FIG. 5. TOOL BLOCKS AND GUIDE BARS.

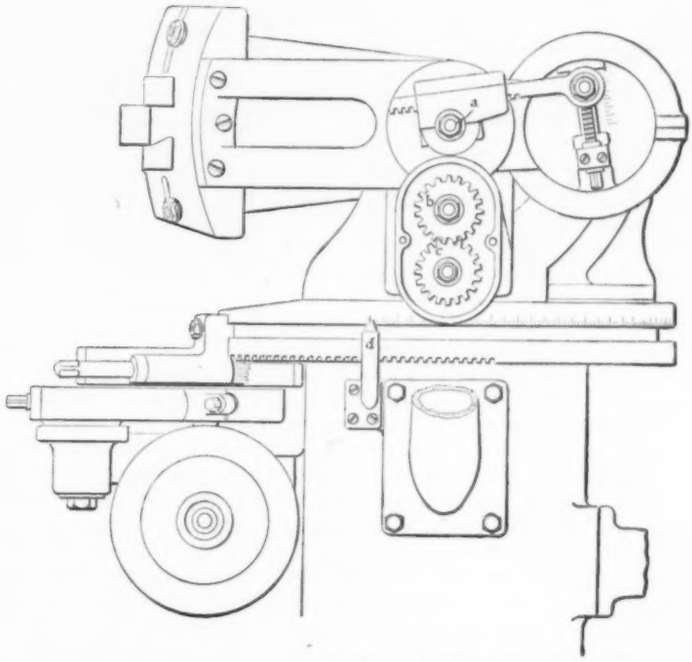


FIG. 6. TOOL-DRIVING MECHANISM.

journalism the combination of easy berths and fat financial returns that brings joy to the bovine spirit, and he further adds that the business end of this particular field has been developed so much more cleverly than the editorial end that a great opportunity awaits the ambitious but indolent pen pusher who thinks the office of a daily paper is too energetic and not literary enough in its atmosphere for his sensitive nerves.

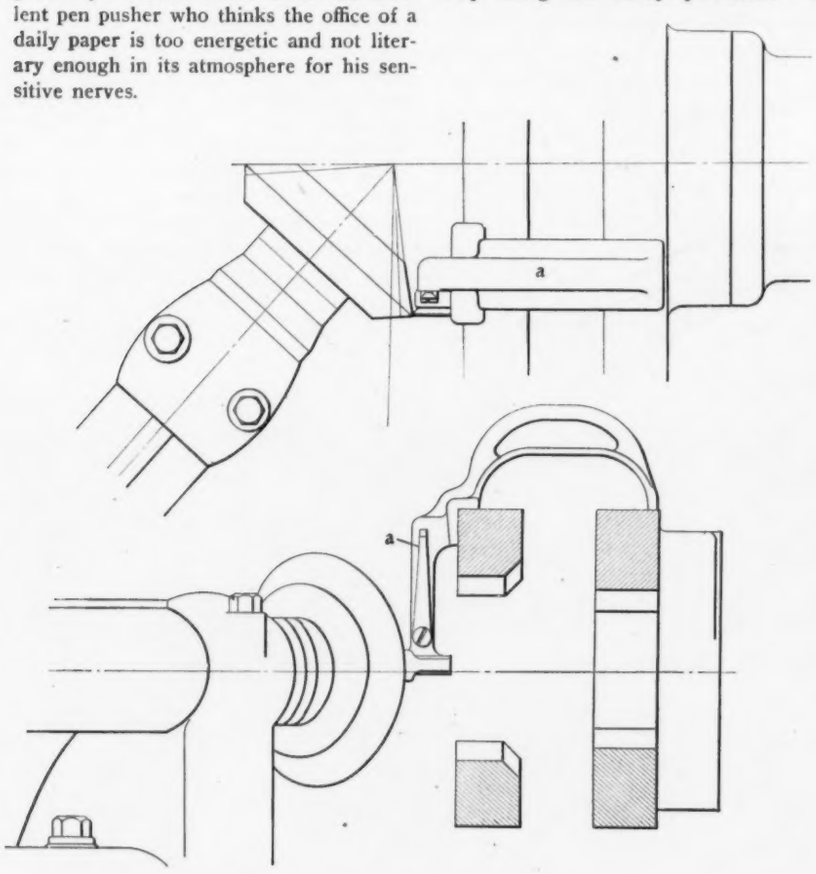


FIG. 7. ADJUSTMENT OF CONE CENTER OF BLANK TO COINCIDENCE WITH CONE CENTER OF MACHINE.

It is possible that these revelations of the conditions in trade journalism will bring an influx of blue blood and bright brains into the midst of this hitherto neglected and unappreciated branch of journalism, and it may be promised that if anybody will show how to describe a new line of planers or an improved method of sewage disposal so as to make it even approach in general interest an account of a good horse race, there is a big place waiting for him in many offices. But even the most enthusiastic press agent cannot conscientiously say that it is easy to prepare a technical write-up of which he can feel proud from a literary point of view. He demands the insertion of his gems of thought on the ground that they refer to things he is advertising, but he also seems to think the editor will be glad to be relieved of the duty of filling the space that is occupied by the write-up of a new lathe, say, telling all about it from the size of its feet to the color of its paint and illustrated by a cut taking up most of a page. Judging from the revelations in the *Saturday Evening Post*, it might be well to head off a legislative inquiry into trade-paper shortcomings by acknowledging that such a publication gains prestige in its special field, not because of any merit in its reading pages, but because of the earnest desire of its subscribers to help along the needy publisher. This critic seems to feel that if there is not enough room in the narrow confines of paid advertising space for the description of a manufacturer's wares the fullness of the reading pages is at his disposal; in fact, that is what they are provided for, and the technical information of an unbiased character which they contain is depended upon only to fill the places not occupied by this trade information for which the subscribers yearn so strongly.

As a matter of fact, a considerable part of the articles referred to is misleading nonsense, and lest some of the readers of them who also look to *The Engineering Record* for information may be misled, it is worth while considering this one feature of trade journalism, the write-up. The author of the two articles states that the reading pages of trade papers are not conducted as well as the rest of the business, and overlooks the fundamental fact that the men who produce those reading pages are employed by the owners of the papers to work along certain lines. If their work was not satisfactory they would be discharged; the fact that they are not discharged shows that they are considered competent. These editors are not responsible for the write-ups that appear in the reading pages, but the publishers are. If it is the policy of a journal to sell its reading pages to advertisers, the editors are in no way guilty. It should be thoroughly understood, however, that the best trade papers do nothing of this sort. All the space they sell or promise to advertisers is in their advertising pages. It is worth all they charge for it, generally more than they charge. The high-grade paper has a large number of subscribers just because of their certainty that whatever appears as reading matter is printed solely on account of its real interest to the readers. These subscribers, the cream of the class to which the publication appeals, are worth reaching by advertising. By maintaining the reading pages free from paid notices, this group of readers is kept so interested in the regular issues of a publication that its advertising pages always form the quickest and best means of telling a business story to the men whom it is desired to interest. But just as soon as the reading pages are lowered by write-ups, the subscription list dwindles in numbers and importance, and for the sake of some trivial gain for a month or a year, the great value of having all the best men in a given trade or profession reachable through a single journal's pages is lost for all time.

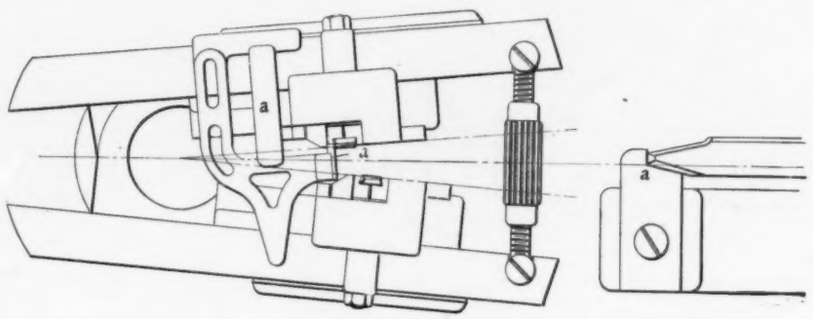


FIG. 8. ADJUSTMENT OF TOOLS.

There is one feature of the write-up that is not rightly appreciated. A few days ago a company sent an advertisement to this journal with the following note: "Other magazines have promised to give us a reading notice if we place an advertisement with them, and we hope

you will consent to do the same." *The Engineering Record* will be glad to notice that material; it has been trying to get the information for the benefit of its subscribers for some time, and it would print it without regard to any advertising. The limitations of the human memory are not widely separated and that article will be forgotten before long, except in a very hazy way. Accordingly the advertisement is necessary to keep the reader reminded of this useful product as well as to attract the attention of the new readers. This is the only true theory of write-ups and advertising. Any trade paper that influences educated classes like those reached by *The Engineering Record* adopts this theory, and any paper claiming to reach such people and at the same time offering to give write-ups in return for advertising is not worth spending any advertising appropriation in.

It must not be thought, however, that any old thing is acceptable for the reading pages of a high-grade journal. It happens sometimes that an advertiser prepares his advertisements in such a poor way that they attract no attention and tries to recoup his losses by contributing similar reading matter for the editor's use. He cannot make his articles of much value in the space for which he pays, and accordingly desires to bring the reading pages, for which he does not pay, down to his own level. No good paper ever countenances such a practice. The editor is the man who represents the subscribers in the organization of a trade publishing house, just as the business manager generally represents the advertisers. The two departments are entirely distinct on all good publications, much more distinct than they are in newspapers, and contributions from an advertiser are judged by the same rules that are applied to everything else. If the contribution is of interest to the subscribers it makes no difference where it comes from; if it is not considered of interest it is not printed. Many manufacturers and dealers appreciate the rules of different editorial offices and fix up their contributions in conformity with them, thereby gaining considerable publicity at little expense. Other companies turn out the most crude type of boyish effusions, without interest to anybody, and claim that discrimination is shown against them when these discriminations are rejected.

Work of a Floor-Plate Boring Mill.

EDITORIAL CORRESPONDENCE.

The readers of the AMERICAN MACHINIST will recall the article at page 581, Vol. 28, Part 2, on the floor-plate boring mill of the Crocker-Wheeler Company adapted for use with a variety of portable tools in machining rotors and stators of large electric generators. The accompanying illustrations show the operation of the machine and of two of the accompanying portable tools on the stator housing of a 4000-kilowatt generator.

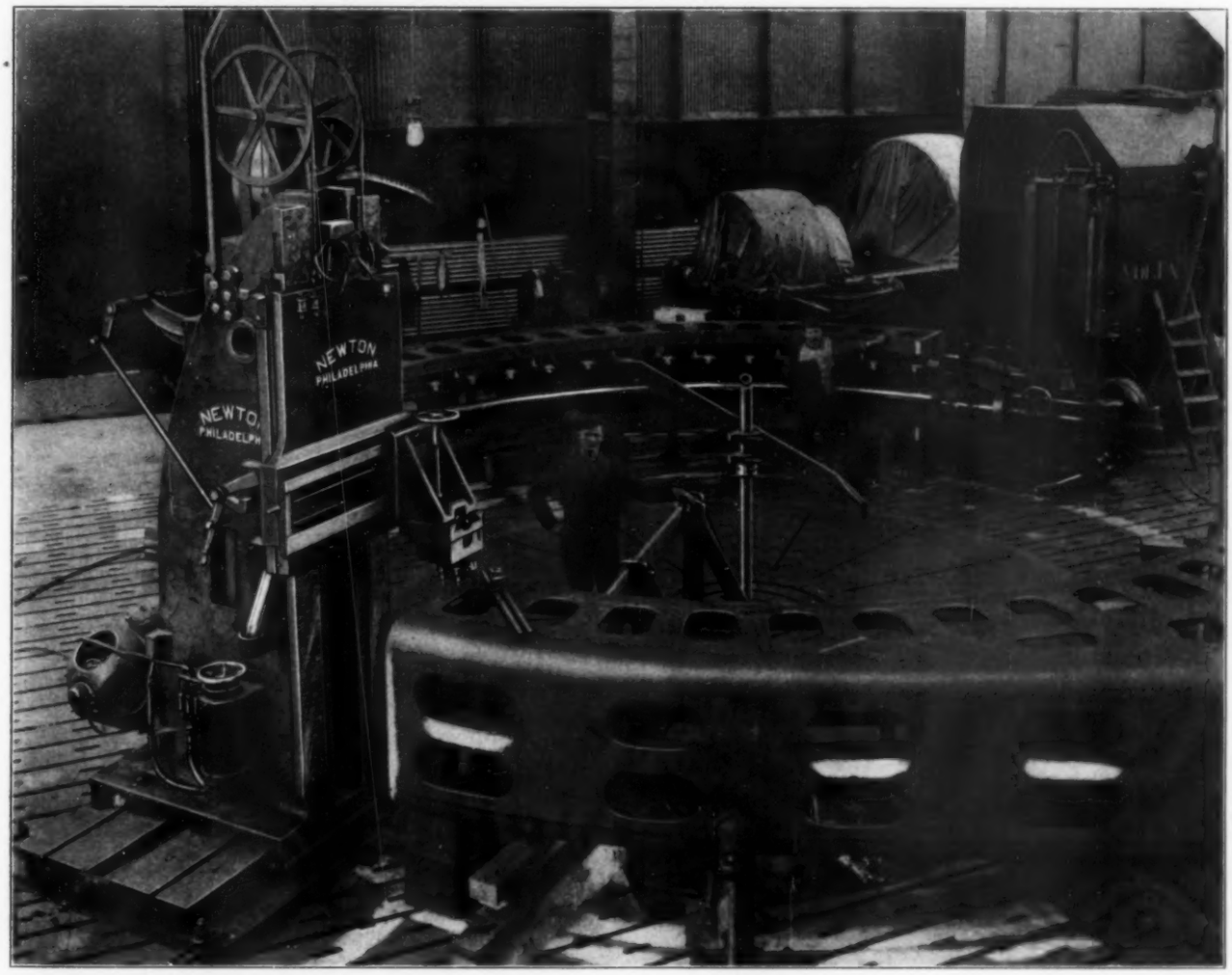


FIG. 1. SLOTTING AND DRILLING A STATOR HOUSING.

The operations shown are but few of the many of which the outfit is capable, but, on the other hand, they show well how the machine may handle work far beyond its own dimensions, and also how in some cases more than one operation may be in progress at the same time.

The housing which is shown complete in Fig. 2 is of about 29 feet diameter, and is made in three segments. Two of these segments are shown in Fig. 1, of which the one in the foreground is having a joint faced by a Newton portable slotter while the one in the background is having

its bolt holes drilled by an Espen-Lucas portable boring and drilling machine. This view also shows how the work is centered to the table by means of a tram bar carried by a bar inserted in a hole with a Morse taper, which hole is in the center of a plug fitting a recess in the center of the table.

Fig. 2 shows the complete housing assembled about the revolving table with its segments bolted together, and in process of being bored, a tool post being mounted on an extension plate which in turn is bolted to the revolving table. The slotting machine is also shown in the background machining the bottom of the feet. F. A. H.

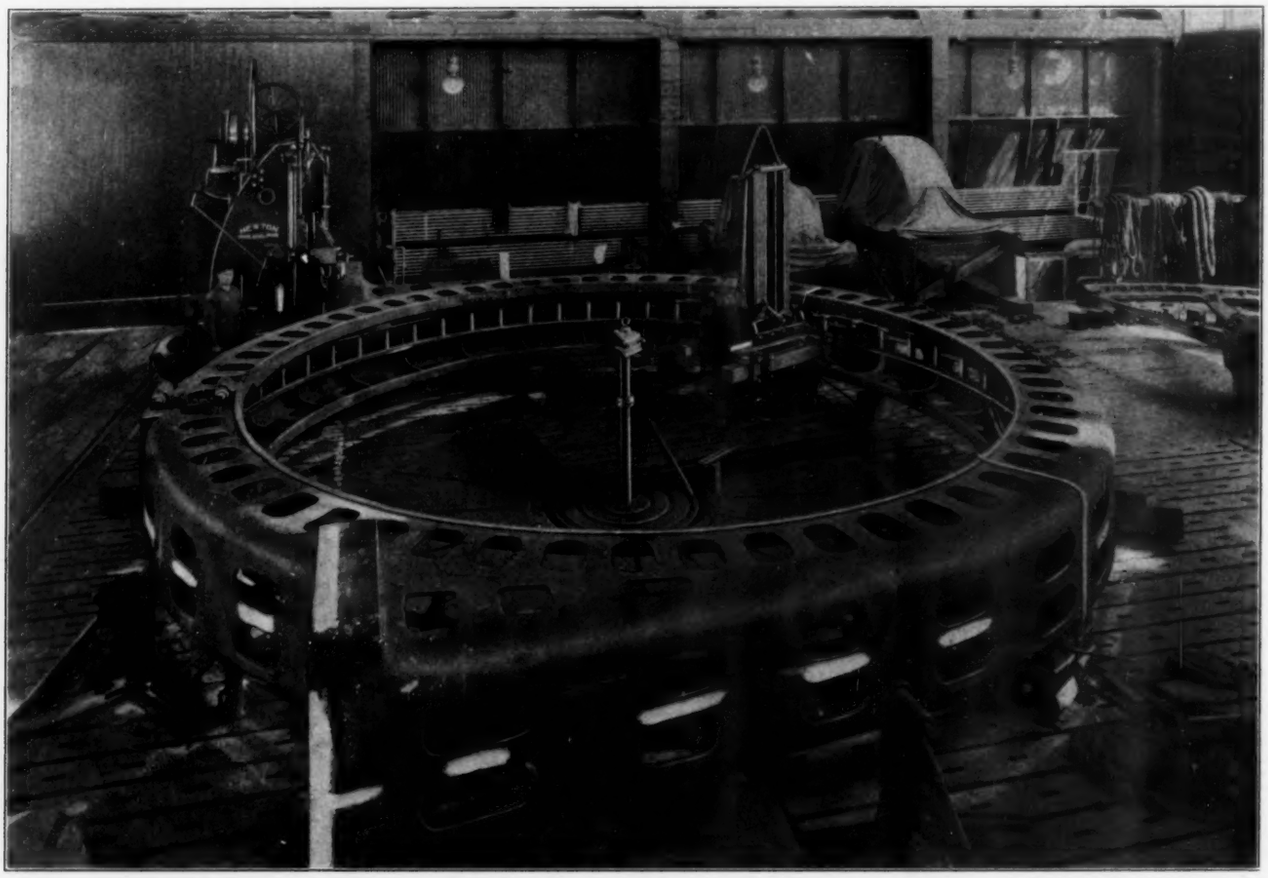


FIG. 2. BORING A STATOR HOUSING.

Report upon Methods for the Examination of Welding and Weldability.

We take the following extracts from a report on the above subject made by Prof. Reinbold Krohn to the International Association for Testing Materials.

It is extremely difficult to formulate a standard test for estimating the *weldability* of a material; such a test should exclude any element of chance, and in addition to defining the shape and mode of working of the test-piece, should also state the manner, duration and degree of heating to which the iron should be subjected before and during the process of welding.

Even if it were possible to prescribe and carry out a standard test which would exclude any personal factor, such a test would scarcly be of practical value.

It is well known that if works accustomed to always welding the same sort of iron have, for some reason or other, to use a material different to that used ordinarily, it is necessary at first to make several tests and trials before obtaining a good weld with the new material. Naturally, welding carried out in regular factory service is not done in exactly the same manner as when welding for a standard test. As, however, as stated above, the quality of the welding depends in a great measure on the way in which the tests are made, a good result from the standard welding test does not in any way guarantee the reliability of the welds made with the same material in large works.

For the *examination of the welds* standard tests, of course, can be devised. In this case the directions and the carrying out of the tests would be much simpler than in the case of the standard test with regard to welding properties of the material. But even tests on the quality of the weld are of little practical value. If a test-piece be taken from a welded part and the quality of the welding examined, the result of this examination gives no correct idea of the quality of the remaining part of the welding. The quality of the welding depends from point to point on the skill, the care and the reliability of the workman intrusted with the work; for the same weld may be good in one place and defective in another. The examination of a single weld, however, can only be used very guardedly in forming an opinion as to the quality of other welds, and, consequently, very little value can be ascribed to standard welding tests.

As a result of his investigation, the reporter recommends that the congress withdraw these problems from the list.

It is reported that the Napier Company in England is constructing a six-cylinder motor-car in which the change-gear method of speed control is done away with, the throttle and spark regulation being depended on altogether.

The new Napier six-cylinder autocar without gear box, mentioned at page 616, has been given a thorough test, traveling through England, with apparently satisfactory results.

The Warner Auto-Meter and Cut-Meter.

BY HUGH DOLNAR.

Time was when a chalk mark on a revolving piece and a watch with a second hand did well enough for the old-style millwright to tell how fast his slow-moving wheels and shafts were turning. Then this rough and ready and uncertain

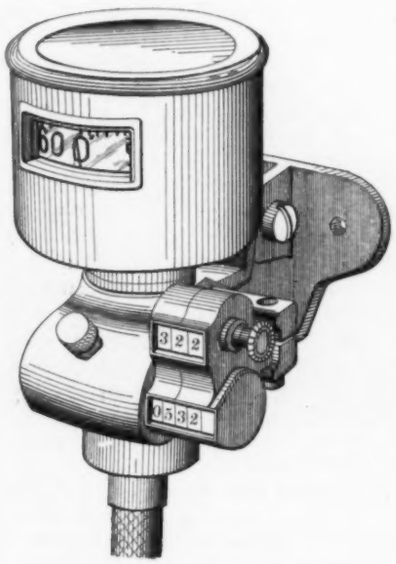


FIG. 1. THE WARNER AUTO-METER.

method was improved by the introduction of "revolution counters", more convenient than the old way, but involving the use of a time piece, and giving only an approximation to accuracy.

The Warner Brothers (A. P. and C. H.), of Beloit, Wisconsin, desired an instrument that would record either revolutions per minute or surface speeds per minute visibly and accurately, and show rate variations in the continual movement of a machine part; and after experimenting with various speed recorders, they conceived the idea of driving an index disk by magnetic force, and retarding it by a spring, so that the graduated dial would stand with the fixed pointer at the dial line correctly indicating either turns per minute or surface speed, according to the form given the instrument.

For revolutions per minute the magnet carrying the shaft must be driven from the revolving piece to be timed. For surface velocity indicating and recording, the magnet and dial-supporting shell or case is provided with a handle, and the magnet shaft has a friction disk fitted to its outer end. The disk is pressed against the moving surface, so as to turn the magnet, and the graduated dial then stands at the mark indicating the surface speed of the moving body.

The success of the Auto-Meter depends upon a fortunate coincidence of action in two wholly dissimilar agents, a magnet and a spring, specified as follows:

If a magnet is revolved in close proximity to a non-magnetic body it exerts a turning force on that body exactly proportioned to the magnet velocity, so that the magnet torque on the adjacent body is twice as great at 200 magnet turns per minute as it would be if the magnet were making only 100 turns in the same time.

Spring resistance to motion increases in the same ratio for free spring end travel, it requiring exactly twice the force to move the free end of a long flexible spring one inch that it takes to move it half an inch.

If this is true (and no Warner recorder could correctly indicate varying speed if it were not true) and the magnetic torque. acting as specified, increases and diminishes in effect on the index wheel exactly in the same proportion that spring resistance varies under more or less travel of the free end of the spring, then it is obvious that some spring may be made to hold the revolving dial at the zero mark when the index dial is free from magnet torque because the magnet is also standing still, and that as soon as the magnet begins to turn the dial will also begin to move, and that the dial will stand still at the mark denoting the magnet speed, so long as the magnet turns at an unchanging rate.

These instruments in their best and most costly forms do record revolution speeds from say 10 to 3000 or more turns per minute to within less than 1/10 of one per cent. of error, thus proving the equality of the magnet and spring ef-

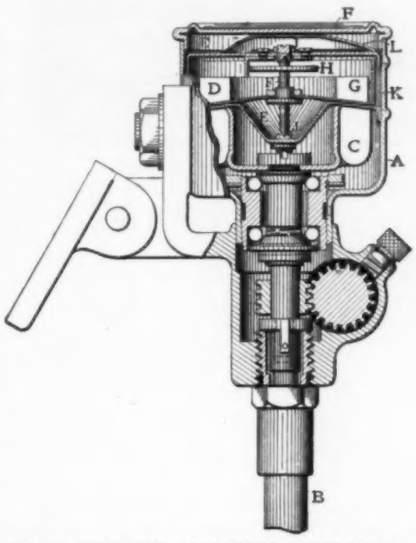


FIG. 2. SHOWING AUTO-METER MECHANISM.

fects at different speeds and in different positions.

CONSTRUCTION OF THE AUTO-METER.

The Cut-Meter was illustrated in the AMERICAN MACHINIST at page 473, Vol. 27. The Auto-Meter is represented herewith in Figs. 1 and 2, the latter showing a vertical section through the brass shell or casing *A* and revealing the mechanism driven by shaft *B*. The magnet is shown at *C* while at *D* is a "magnetic mass" attached to the underside of cup *E* which forms a part of the inner case. *F* is the pivot or shaft for the dial *G*, and *H* is the hair spring near the upper end of the

FIG. 3. GRINDING POINTS OF DIAL PIVOTS.

shaft. The magnet shaft, which also drives the Veeder odometer through 8 to 1 worm gearing, is carried on ball-bearings, and the pivots for the record dial *G*, magnetic current driven by the turning of the permanent magnet which does not touch the dial, are carried in 90-degree sapphire jewel bearings. The recording dial must revolve with as little friction as possible to indicate small variations of magnet speed and must also have the least possible weight for its size, which must be considerable to give the dial graduations sufficient extent to be easily read. The dimensions adopted for the dial are 2 inches diameter by ½-inch face, the dial taking the form of a cup, drawn from aluminum sheet stock 0.02 inch thick.

OPERATIONS ON DIALS AND PIVOTS.

The dial pivots are about 1/16 diameter, cut from tool-steel rods with a 120-degree angle pointed tool into lengths of about 1 inch, which, owing to the angle of the parting tool, have 60-degree angle cone points. These pivots are hardened, and not straightened afterward. The pivots are chucked as in Fig. 3 in American watch lathes close to the end and have the cone points finished by grinding with emery wheels and polishing with Vienna lime, the extreme points being finished by a second lathe operation with a square oil stone in a girl's fingers, so that the extreme pivot end is truly rounded to a very small globe radius.

This operation demands both care and skill, as it is free hand work.

To mount the dial on the pivot a brass

FIG. 4. APPLYING GRADUATED PAPER RINGS TO DIALS.

blank is first forced on the pivot body, then this blank is turned with the pivot ends in female centers in a watch lathe to form a wide flange and a body tapering 0.003 inch in a length of about 3/16 inch. The dial shells have central holes which go close on the taper bodies, and the dials are retained by forcing a brass collar, of the same diameter as the dial holding flange and about ⅛ inch thick, on the projecting end of the tapered brass hub-body.

Turning the flanged brass hub on the pivot ends in female centers brings the hub-body and flange true with the rounded ends of the pivot, regardless of the crook of the pivot body caused by hardening; this crook is very slight, the inch-long pivots appearing straight to the eye, but very few of the pivots are absolutely straight.

The dial graduation, either 60 or 100 spaces and lines, on paper strips, is printed in black, long 5th lines, with gothic numerals of good size so as to be easily noted, at each 10th mark. These index strips of paper are exactly long enough to go round the dial edge, are joined with court-plaster inside, and are then forced on the dials with a small hand press, seen in Fig 4, to within ⅛ inch of place. The projecting ⅛ is then coated inside with shellac varnish, and the paper ring of graduations is forced home.

The dials must be exactly balanced, and the balance weights added are aluminum slips. The dials are placed between female centers in a fixture, Fig. 5, the head of which is friction-retained in its support at any angle, so that the dial pivot or shaft may stand horizontal or vertical, or at any angle between, on either side of the center. The face plate has an index pin, and the zero is set to the index, as a matter of routine only. The dial is then moved to horizontal pivot position, when the heavy side falls to the bottom, and a piece of the aluminum balance strip, ⅜ inch wide, and 0.002 thick, is cut off with scissors and slipped between the paper and the dial shell. The balance is tested by turning the wheel pivot to various angles, and if too heavy the balance is reduced by scissors, or if light is augmented by small pieces added on each side. When the balancing is perfect the dial stands still, in all positions of the pivot or staff. After balancing the dials are placed in a side truing fixture in centers, with a milled-head screw next the rim on the web side, and the dial is turned by hand and the high side pushed over with the milled-head screw. A girl balances and trues from 60 to 65 dials per 10-hour day.

FIG. 5. BALANCING DIALS.

MAGNETS AND MAGNET SPEEDS.

The faster the magnet turns the harder it pulls on the dial, and the stronger the spring must be to resist the magnet pull. The slower the magnet turns the less the turning effect on the dial, and the weaker the spring required to resist the dial turning.

The magnet speed adopted as most suitable for the Cut-Meter is 500 revolutions of the magnet per minute to make one complete turn of the index wheel, for speeds up to 250 feet per minute, which is about two magnet turns for one foot of surface speed, and this proportion is maintained for higher surface speeds so that for an extreme range of say 750 feet of surface speed per minute the magnet would be given 1500 turns per minute.

For automobile recorders the dial makes one complete turn when the magnet makes 1360 turns per minute, and the Auto-Meter dials are graduated in either 60 or 100 divisions; with 100 divisions a stronger spring is used than for 60 graduations, so that the index registers 60 at 1360 magnet turns, and the magnet must make $1360 + (1360 \times \frac{2}{3}) = 2266$ turns per minute to cause the 100-mile graduated dial to make a full turn.

In these instruments was first tried a straight bar magnet, then a U-shape, with the shaft at the bottom, and the dial close to the top of the magnet. The next change was a gap 1/16 wide, and the magnet placed with its side close under the index wheel. Then a "magnetic mass" was placed above the dial, and a stationary thin brass disk was placed as a wind-shield between the under side of the dial and the magnet.

The magnetic mass concentrates, collects, or directs, the lines of magnetic force by which the revolving magnet takes hold of the dial disk and turns it, so that the dial is very much more strongly driven with the stationary magnetic mass placed above it than without. The wind shield (forming a part of cup *E* Fig. 1) between the magnet and the dial disk is also a necessity, as air friction on the dial causes it to over-indicate as magnet speed increases.

The magnet now used is 1⅞ inches by ⅝ inch thick with a 1¼-inch hole in the middle, and gap, milled, 1/16 inch wide.

The magnets are formed by coiling the hot bar on an arbor in lengths of 20 to 24 inches, then cutting the gaps in the milling machine, then heating the separated blanks and flattening under a drop hammer, then hardening in a salt water bath as hard as may be. The material is

FIG. 6. PLACING MAGNETIC MASS.

imported tungsten steel. After hardening the blanks are magnetized by laying them for 10 seconds on a powerful electro magnet, and finally the magnets are "aged" by secret treatment. This "aging" considerably reduces the magnet strength, but makes it keep what is left permanently.

It will be observed that magnet production involves no machining of the

sides, bore or edges. Any finishing of the magnet surfaces either before or after magnetizing greatly reduces its power and the magnets are therefore left rough, except for milling the gap-cut. They are fixed to their driving shaft ends by forcing drawn brass cups into the central hole, and are held to the tapped shaft ends by one screw, fitting a hole in the center of the brass cup bottom, and turned hard into the axial tapped shaft hole.

Magnets identical in material, form and treatment vary greatly in strength and torque of dial supplied, but as the torque is rapidly reduced by moving the magnet away from the dial, small variations in position make the magnets all drive the dials so nearly alike that the same length and weight of hair spring, adjustably placed, serves for all the dials.

FIG. 9. FINAL TESTING.

This hair spring is heavier than is used for watches but is supplied by the trade, both foreign and American makes of springs being used. The hair spring free end is fixed in a saw-cut in a brass collet by staking, and the collet is forced on the dial pivot. The fixed end of the hair spring is adjustably pinched in down-hanging screw-actuated vise jaws, integral with a slotted retaining brass quadrant.

The magnetic mass is held by screws to the bottom of the sheet brass drawn cup, which slips inside the drawn brass shell forming the recorder case or shell. Fig. 6 shows the method of attaching.

FIG. 7. ROUGH TESTING BENCH. FIG. 8.

AUTO-METER DRIVE.

For motor car service the Auto-Meters are driven by a flexible shaft composed of an assemblage of Hooke's joints, this shaft being driven from the right-hand front wheel hub of the car, the drive ratio being about two turns of the flexible shaft to one turn, through pairs of spur and miter gears, of the front wheel. A curious and elaborate mounting, including a turntable and slotted angle plate, is employed to support an aluminum bracket, having bored seats at right angles to lead the drive from the car wheel to the flexible shaft, the arrangement being such that the swing of the front wheel in car steering is not transferred to the flexible shaft. At first no less than 360 different special mountings were used to apply the Auto-Meters to different cars. Now only about 12 special mountings are used, these fitting cars most largely used, the adjustable mounting serving for all the others.

CALIBRATION.

Upon the completion of assembling the recorders are "calibrated," that is to say, are driven at a known speed, and the magnet is moved to or from the dial wheel or shell, until the index stands at the known speed record; which is about 200 turns per minute in the assemblage of calibrating elements used. The first, shown in Fig. 7 and 8, is a stand which has a horizontal spindle, controlled to about 200 revolutions per minute, a stepped cone, a plain cone, and a friction-disk and hand-screw shifted traversing pinion which gives speeds from zero to maximum. The stepped cone is used for Cut-Meter calibration. The horizontal spindle gives the Auto-Meters driving calibration tests. The plain cone is used for Cut-Meter testing, affording ready visual evidence of the action of the instrument at varying speeds when its friction wheel is moved along the cone by hand. The stepped cones have, of course, approximate fixed and known surface speeds. In this first calibrating assemblage, known as the "rough testing stand," the spindles and cones are driven to within about 2 or 3 per cent. of 200 turns per minute; this regulation is by a 4-spring arm and weight centrifugal governor acting on a disk carrying 4 leather plugs, perhaps 1 inch diameter revolving at 2 inch radius.

FIG. 10. FINAL INSPECTION.

The instruments, after passing the rough testing stand, go to the final testing stand Fig. 9, and are driven in succession by seven different spindles varying in speeds from 1000 to 10 turns per minute. The variation in rate from accuracy

is about 1/100 of one per cent. The vertical driving spindle which is motor-driven at nominally 1000 turns per minute, is controlled by a novel form of centrifugal governor, not described in detail. I am, however, permitted to say that the governor is a one-ball spring-arm arrangement fixed in the covered hollow of the large gray-iron fly-wheel on top of the vertical motor shaft, and that the extremely delicate governor does not act upon the principal and more powerful motive element, but upon a comparatively feeble auxiliary motive element, which either aids or opposes the principal drive. A very close approach to absolutely timed rotation is thus obtained. This calibrating stand is in a room by itself with a good chronometer, which rings a bell once a minute, and the vertical spindle rings a bell once every 1000 turns; the two bells commonly strike at the same instant, and are never more than 5 seconds apart at the end of 10 hours' run, in which the errors of the shaft rotation are plus or minus accumulative, and the bell strokes are often not more than 2 seconds apart for 10 hours' run. The recorders are corrected to give accurate dial readings at the seven spindle speeds. For those used on automobiles and in the form of Cut-Meters the adjustment and testing are continued until the dial reading errors fall within 1/5 of one per cent. I was shown a tachometer to be used in testing work for the United States Government, which read to within 1/25 of one per cent. at from 50 to 130 turns per minute. An anemometer just completed to the order of the United States Board of Ordnance, to be used in gunnery tests, is sufficiently delicate to record correctly a wind velocity as low as 2 miles per hour.

Much use is said to be made of anthracite coal dust in some of the Canadian provinces.

Some Turret Fixtures.

BY H. F. NOYES.

The engravings illustrate some turret fixtures used in the works of the Landis Tool Company at Waynesboro, Penn.

The first of these, shown in Figs. 1 and 2, is a simple arrangement designed to facilitate the handling of lathe work requiring a number of differently shaped tools. For instance, in Fig. 3, is represented a general form requiring right- and left-hand facing tools, a tool for relieving at *A* for grinding, and a roughing tool. The number of tools required would of course vary with the work, but for this particular case four were used.

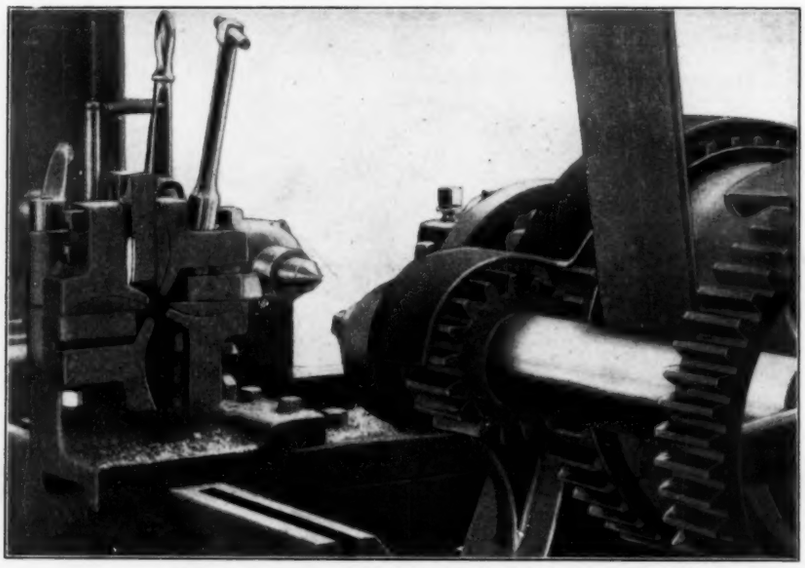


FIG. 1. A TURRET ATTACHMENT FOR THE LATHE.

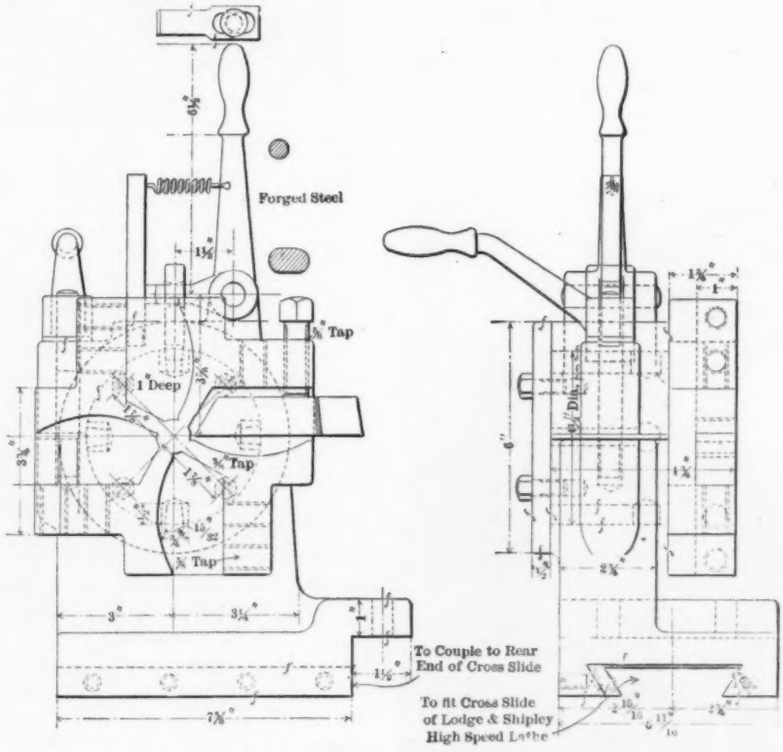

Forged Steel
⅜" Tap
1 Deep
⅜" Tap
⅜" Tap
To Couple to Rear End of Cross Slide
To fit Cross Slide of Lodge & Shipley High Speed Lathe

FIG. 2. SHOWING TURRET CONSTRUCTION.

The fixture comprises a main casting planed to fit the cross slide on the lathe carriage and fastened to the slide rest so as to move therewith. This casting carries a turret head, adapted to rotate on a horizontal axis, and provided with recesses to receive four tools. It is also provided with an indexing arrangement adapted to locate the head in four positions suitable for each of the four tools and provision is made for clamping the head firmly in position.

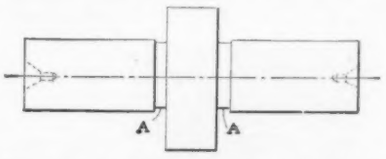


FIG. 3. PIECE MACHINED BY TURRET ATTACHMENT.

The second of these fixtures is used for turning the concave path in the friction disk illustrated in Fig. 4, and was designed by Mr. Stone, the firm's superintendent.

It is arranged to be used on a Bullard turret lathe, in connection with the turret, and is so constructed as not to require any changing of the work, nor to interfere with any of the other operations of the turret.

This fixture is illustrated in Figs. 5, 6 and 7 and has as its main member a heavy bridge piece pivoted at one end to a plate which is fastened to the back part of the lathe carriage, while the other end is adapted to be clamped to the front of the carriage by a plate which is readily re-

movable. The fixture is located just in front of the turret (which is carried on the cross slide and provided with power feed), and may be thrown back against a stop out of the way of the turret when the lathe is in use for other operations.

The bridge is provided with a rotary

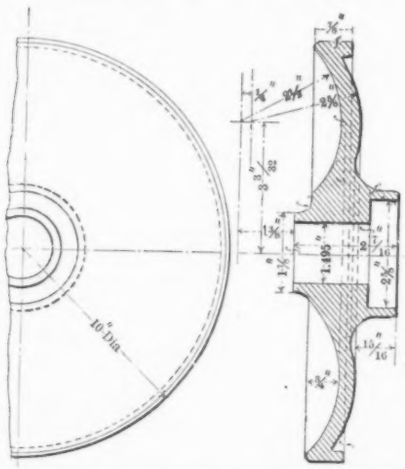


FIG. 4. FRICTION DISK TO BE MACHINED.

head, carrying three tools which are set to a gage, the tools being equally spaced so as to give each about one-third of the turning arc to cover. The head is provided with a segmental gear adapted to mesh with a rack, the latter being fastened to the turret in place of a tool.

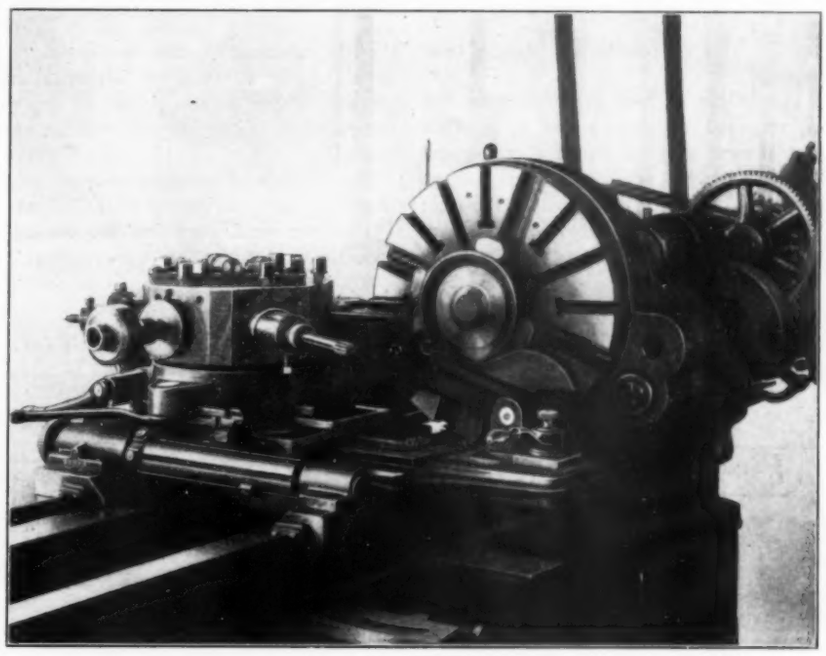


FIG. 6. REAR VIEW OF FIXTURE FOR MACHINING FRICTION DISKS.

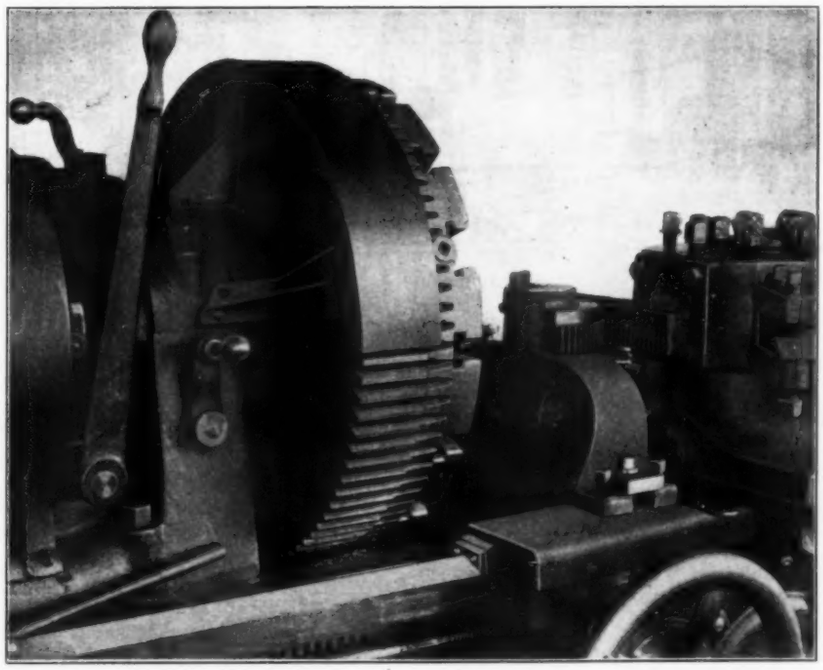


FIG. 5. FRONT VIEW OF FIXTURE FOR MACHINING FRICTION DISKS.

It will be readily understood that the cross feed of the turret induces a turning movement of the rotary head, thus roughing out the concave path in the disk to the required form.

The means for grinding these disks will be described in another article.

The train rules committee of the American Railway Association has changed some of the definitions in its code. One of these is that of the word "engine" which was formerly defined as "a locomotive propelled by steam." In the new definition an engine is a "locomotive propelled by any form of energy." The term will therefore now include not only electric locomotives, but also vehicles propelled by gasolene or other motors, with which there is now a tendency to experiment in this country. "The world do move."

Rational Methods of Gas Engine Powering.

BY SANFORD A. MOSS.

The following notes can be added to the article at page 381 on this subject.

Typographical errors—page 381, middle column, line 8, formula for piston speed should be $\frac{Nl}{6}$. Page 383, last column, line 7, formula for r.p.m., should be $\frac{800}{\sqrt{l}}$.

It should be noted that Table 1 gives directly values of m.e.p. for natural gas and manufactured illuminating gas, but that slight corrections must be made for other gases, given by factors of Table 5.

In Table 3, deduction is made for oxygen supplied by the gas itself. There is one cubic foot of oxygen in 4.782 cubic feet of atmospheric air. Hence 4.728 × the number of cubic feet of oxygen per cubic foot of gas gives the deduction which can be made in the cubic feet of air required for combustion of a cubic foot of gas, on account of the presence of the oxygen.

In Table 3, the heat of combustion of a mixture of a cubic foot of gas combined with 5.649 cubic feet of air, the requisite amount for perfect combustion, is 575.8 B.t.u. That is, a total volume of mixture, 5.649 + 1 cubic foot gives 575.8 B.t.u. Hence the heat of combustion of a single cubic foot of the perfect mixture is 575.8 ÷ (5.649 + 1).

In Table 4, the distinction between the last column, and the third one from the end must be noted. The third column from the end gives the heat of combustion of a mixture consisting of a cubic

foot of gas with the volume of air required for its perfect combustion. The air for combustion is given in the next to the last column, and the total volume of a perfect mixture containing 1 cubic foot of gas is found by adding 1 to these values. The heat of combustion of a single cubic foot of perfect mixture, given in the last column is found by dividing the heat of combustion by the total volume.

The values of heat of combustion and air required for combustion of a cubic foot of pure gasolene vapor at 60 degrees and 14.7 pounds per square inch are not given. This is because widely different values of density of gasolene vapor are given by various authorities, probably

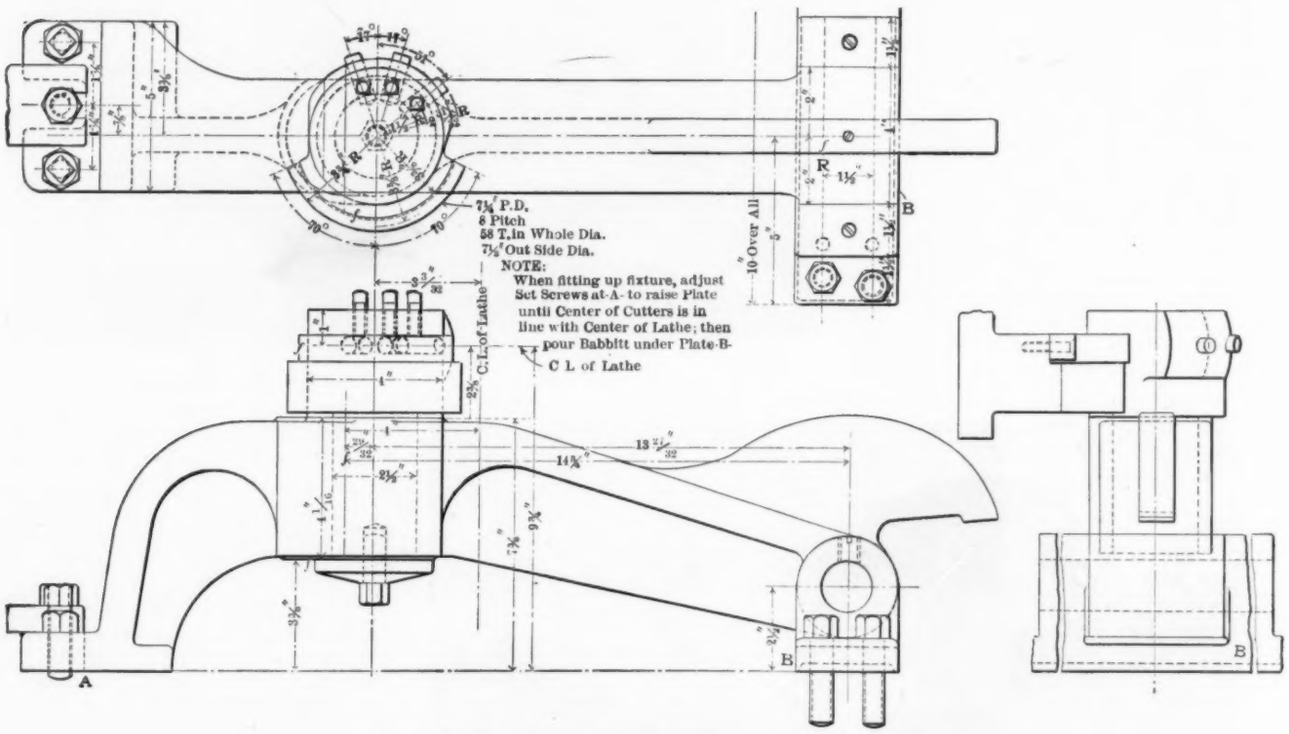

7¼" P.D.
8 Pitch
58 T.in Whole Dia.
7½" Out Side Dia.
NOTE:
When fitting up fixture, adjust Set Screws at-A- to raise Plate until Center of Cutters is in line with Center of Lathe; then pour Babbitt under Plate-B-
C L of Lathe
C. L. of Lathe
10 Over All
A
B

FIG. 7. SHOWING CONSTRUCTION OF DISK-TURNING FIXTURE.

because gasolenes vary greatly. Average values are 4000 B.t.u. per cubic foot of pure gasolene and 40 cubic feet of air for combustion of 1 cubic foot of pure gasolene. These figures may be inserted in the blanks in Table 4. The values given for kerosene are also somewhat uncertain.

The heat of combustion and air for combustion of 1 poumd of gasolene and kerosene are known with greater exactness than the vapor density, however, and hence the heat of combustion of a cubic foot of perfect mixture is fairly definite. This is because the air volume in a perfect mixture is so great and the vapor volume so small, that the vapor density does not have much effect.

For both gasolene and kerosene, the heat of combustion is about 19,000 B.t.u. per pound, and there are required about 15 pounds of 196.4 cubic feet of air at 60 degrees for combustion of 1 pound. The volume of 1 pound of vapor is about 5.6 cubic feet, so that a perfect mixture containing 1 pound of fuel has a volume of about 202 cubic feet. The heat of combustion of 1 cubic foot of perfect mixture at 60 degrees and 14.7 pounds per square inch is therefore about 19,000 ÷ 202. In working out the tables, figures slightly different for the two cases were used. Various kinds of kerosene and gasolene differ so much that no general computation can be expected to be very exact.

For the case of kerosene mixture which usually enters engine cylinders at about 150 F., the heat of combustion for cubic foot of mixture at 60 degrees must be multiplied by the absolute temperature ratio $\frac{460 + 60}{460 + 150}$.

The Telephone Census of 1902.

The final report of the telephone census taken in 1902 by the Bureau of the Census, Department of Commerce and Labor, is now ready. This report contains also figures of the telegraph industry, electric fire alarm systems, and police patrol systems.

The total mileage in 1902 of the commercial telephone systems was 4,779,571, and the number of telephones, 2,225,981; in addition there were many mutual and independent lines. The number of salaried employees engaged in the telephone service was 14,124, and the average number of wage earners, 64,628. The amount paid in salaries was $9,885,886, and in wages, $26,369,735. There were 44 Bell systems, which claimed 7/10 of the wire mileage of all telephone systems and more than one-half of all the telephones. The "middle West" stands well to the front in the use made of the telephone, Ohio leading in the total number of messages, with 558,707,801, and Illinois was next with 541,161,932. In long distance and toll traffic, Pennsylvania was first with 20,409,621 messages, and New York was a close second with 20,367,024. The greatest number of local messages, 547,238,743, was reported for Ohio, and the next largest, 535,744,349 for Illinois. The average revenue per telephone amounted to $37.50, and the average per message to 1.7 cents, while the average operating expense was $24.56 per telephone and 1.1 cents per message. Reports were received for one system in Alaska and for one in the Philippines, and seven in Hawaii. For these nine systems there was an aggregate of 5,518 miles of wire, 2,891 telephones, and 3,887,925 messages.

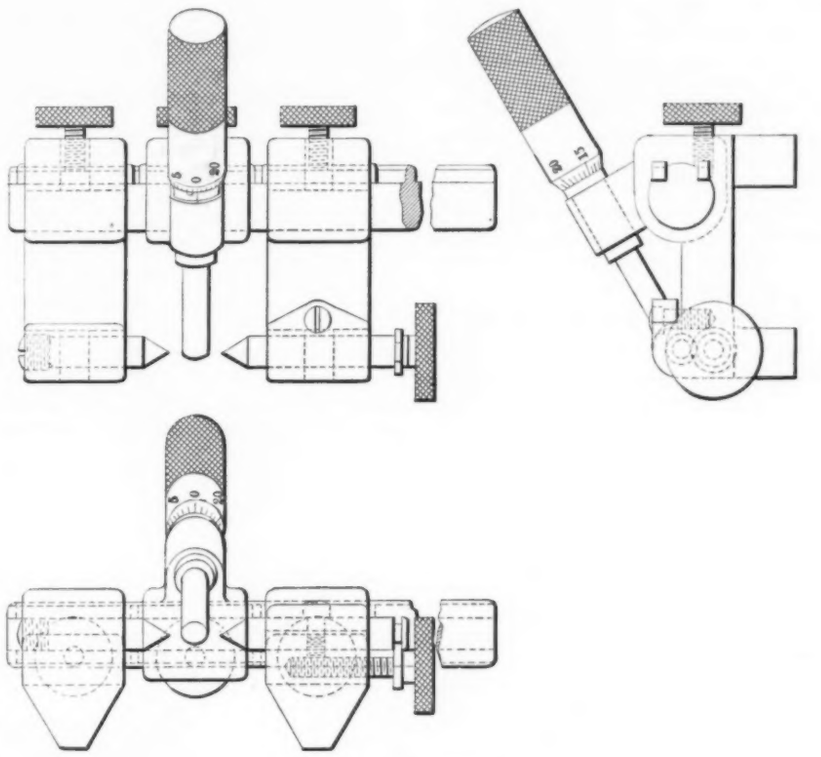
Electrical fire alarm systems were installed as early as 1852, and by 1902 there were 764 of them in operation. Massachusetts has the greatest number, 106, and the next largest is 70 for New York. In 1902 one-fourth of the 39,635 miles of wire were underground, this practice undergoing rapid increase.

Palladium is about the hardness of platinum, is readily rolled, and is usually found in commerce as thin sheets or foil.

Letters to the Editor.

A Micrometer Radius Gage.

The micrometer radius gage shown in the illustration was designed for testing the accuracy of small eccentrics and cams. Its design and construction allow it to be utilized for various other purposes, such as the testing of tapers, and the measuring of taps and reamers which have odd or uneven numbers of flutes or cutting edges. The gage as designed for the purpose referred to has a capacity for measuring radii ranging from 0 to 1 inch on pieces from 1 to 6 inches in length. The eccentrics and cams were put on mandrels for the purpose of testing. As the gage tests to 0 it is available for obtaining the exact center when grinding half round taper reamers.



A MICROMETER RADIUS GAGE.

The two brackets and the bar, which form the base, and the central piece to which a commercial micrometer head is fitted, are made of machinery steel. The periphery of the bar and the contact surfaces in the V-shaped grooves are finished by grinding. The gibs, of which there are two in each piece, are made of tool steel, and the wearing surfaces are ground and tapped. Each of the three parts can be moved along the bar and clamped into the position best suited to the piece to be measured. The method of clamping as shown, assures perfect alinement and a secure hold. The accuracy of the gage is tested by placing a true piece of a known diameter between the centers, and bringing the micrometer screw into contact with it.

H. E. R. MANBRAND.

Notes on the Cam Chart.

Either your proofreader or my very unfortunate penmanship has caused me some trouble.

In my article at page 335 you even turn my name upside down. I signed "Roy John" and you printed "John Roy."

On page 337 under 3, for "The method of locating keyways is slow, inexpensive and unnecessary," I wrote *expensive*.

In the tenth line in the next paragraph to this one, "It is unnecessary to core, etc.," should read "It is necessary."

There are several others, but I will only mention the one which caused me the trouble. At page 335, second column, sixteenth line, "For this reason I wish he had discussed cam and *short* systems differing from his own." I wrote this "Cam and *chart* systems". I am sure there are a good many chart systems in use whether Mr. C. F. Smith knows only one, and that the right one, or not.

My contribution was intended as a statement of, and not an argument for, my system, but since the above-mentioned errors have called out an explanation, I should like a little space for a rebuttal.

A careful reading of Mr. Smith's first article and his rejoinder at page 490 could be summed up in part somewhat as follows:

(1) Lay out a cam chart with curves overlapping, because:
  (a) It takes less room.
  (b) It does not confuse those who are thoroughly familiar with it.
  (c) By the use of differently colored inks and broken lines, its reading is helped.
(2) Make a chart full size and do not dimension.
(3) Lay out each curve complete and exact so that every point in each cam path is shown, because:
  (a) I want to know what position each cam has to the others in every degree of revolution,
    (1) Because (Why?)
  (b) Other advice than this is poor advice for beginners.
(4) Make no angle of cam path greater than 30 degrees, because:
  (a) From my experience and judgment I have adopted this as a standard rule,
    (1) Because (Why?)
(5) Locate keyways in cams before the path is cut, because:
  (a) The form of cam does not yet appear on the blank, because,
    (1) I have never used cams with pathways and never will.
  (b) The cams can be readily assembled on the machine and the keyline marked.

It will be noticed that all the above are arguments founded on one man's experience and more or less empirical deductions.

Over against his argument we might set something like this:

(1) Lay out a cam chart with curve for each cam occupying a space and base line all its own, because:
  (a) In this way the whole path of motion of any cam is shown at a glance.
  (b) No extra or artificial means are necessary to help its reading.
  (c) The inspector who checks up the timing of the machine will be able to follow it easier, because:
    (1) An inspector is frequently not draftsman enough to read a more confused or complex chart.
  (d) It is easier for a beginner to follow one curve at a time.
(2) Make a cam chart of any convenient size and dimension for both movement of cam and of working point, because:
  (a) No matter what scale we may make the chart it cannot represent full size both the above points, for
    (1) The cam is generally of a different throw from its working point.
(3) On machines, the general nature of which is known beforehand, it is wisest to plot out accurately only the paths which are interdependent, because:
  (a) Motions which are absolutely independent can be represented just

as well as by straight lines, for

(1) We only care to know where they start and stop.

(4) It is very desirable to keep the cam path down to an angle of 30 degrees or less, but this should be a general, not a rock-bound rule, because:

(a) Slides carrying cams with an angle of 60 degrees and making 130 reciprocations per minute have run for five to ten years without undue repair.

(b) There is nothing definite or peculiar about this particular angle, for

(1) Just as 20 degrees would make easier motions, so 40 degrees would make harder motions, and

(2) It is only a question of what per cent. of lost work you are willing to assume, and

(3) Even 30 degrees at, say, 250 revolutions per minute would be less desirable than 40 degrees at 25 revolutions per minute.

(c) Strict adherence to this rule on slow running machinery would sometimes increase the cost beyond what either the manufacturer or customer would authorize.

(5) Locate the keyways in the cams from the chart alone, and take great pains to check this work, for

(a) Some cams are not cut at all, merely cast and finished with a file.

(b) Large heavy duty cams with inserted tool-steel faces are far cheaper cored out for paths and steel pieces.

(c) Some large cams must have teeth in the periphery located in a definite relation to keyway and cam curve.

(d) Tool-steel cams must be forged to shape, because:

(1) It is too expensive to cut only.

(e) "No system of assembling or trying out could be tolerated with cams weighing from 200 to 1000 pounds" for,

(1) It is too expensive to handle such large pieces on and off of shaft.

(2) By a little care it is possible to key-seat them correctly and force on the shaft at once and have them fit and work properly.

It will be seen that not one of the above arguments depends on any one man's experience or judgment, but the proposition is stated, with its reasons, to be accepted or rejected as any man's judgment tells him, which is as far as we can go.

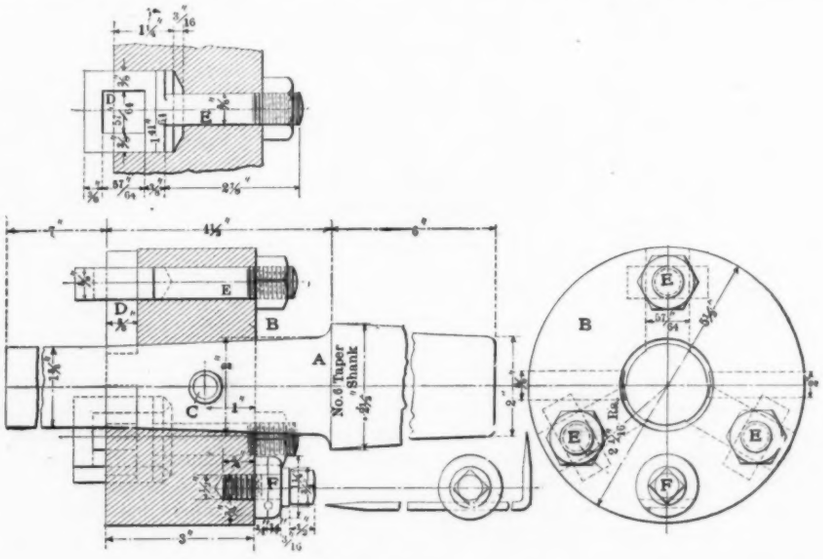
Mr. Smith's statement that my young man would not have gone far wrong with his system is correct, and, indeed, there is no reason why he should have gone at all wrong if getting easy motion was all that was concerned. But a young draftsman's first duty it to do what he is told. If he has learned to draw in the first angle and goes where the third is used, he should use the third, and not attempt missionary work; similarly, if he has learned some other system of cam and chart work and goes to work for Mr. Smith, he should use Mr. Smith's, just as he would drop Mr. Smith's for, say, Zeuner's diagram if he were to go to an engine company.

In closing, let me state again most clearly that I read Mr. Smith's article with a great deal of appreciation and got many helpful suggestions from it. I have recommended it to a number of others who have read it with pleasure and profit. With beginners in the subject there seems to be little trouble in understanding anything except his chart, which is pretty hard, for those whom I have seen, to master.

I venture to suggest that the methods and systems he outlines are better adapted to the design of machines that are to be built only once, or seldom, than to general economical manufacture where the machines are to be made in large quantities and in competition. ROY JOHN.

A Boring and Reaming Head.

The accompanying sketch illustrates a boring and reaming head which is used in connection with either the vertical milling machine or drill. It is built for heavy work, machining forged steel connecting rods. The No. 6 taper shank on the arbor *A* fits into the machine spindle and the lower end serves as a guide, having a bearing in the machine bed plate or jig when the latter is used. The tool head *B* is made of soft steel fitted to the tapered arbor *A* and held in position by the taper pin *C*. The three cutting tools of 1-inch square steel are ground down to fit the slots *D* and are held in position by the special bolts *E*. A scribing attachment *F* is fitted to the top of the head.



A BORING AND REAMING HEAD.

California. BAYARD.

Metric Screw Threads.

Referring to the letter by O. S. Bickford that appeared at page 549, I presume the thread referred to is the same as the international screw thread, which was, as stated by your correspondent, adopted by the International Congress at Zurich (1898, not 1889). I have not seen any report published by the International Congress, but it would be interesting to know what mandate they had to justify their title, and whether countries using the Whitworth and Sellers threads were represented at the congress, and, if so, from whom these representatives got their authority.

Whatever may be the source, it is regrettable that a new form of thread should make its appearance so late in the day, and as some people may be led to adopt it if only on account of its imposing title, it is worth discussing.

At first sight, the Zurich thread, with its flat crest and rounded root, would appear to be an unhappy compromise between the Whitworth and Sellers forms of thread. Searching for reasons of this peculiarity, I would imagine that it is due to the appreciation of two facts. *Firstly*, that the Whitworth method of rounding the root of the thread is superior to the Sellers form of sharp corners, and, *secondly*, that a single-point threading tool with rounded point can be ground as easily and as accurately as one to produce the Sellers thread. The latter is not commonly known, or it would be more generally used, but, as I presume many know of it, I do not propose to give any details of the simple method by which this can be accomplished. In this respect then, the new thread would appear to be one point better than the Sellers, but I think it still remains one point short of the Whitworth.

It is a pity the congress did not recognize the impossibility of producing a flat crested thread with *dies*, and of retaining that shape of thread for any length of time on a screw in use. Had they done so, they would not have found it necessary to depart from the Whitworth principle in this respect.

On further consideration, it would seem to be the intention that dies would not be needed to size the flat top on the screw, as this could be done by another tool, and that the hole to be tapped could be drilled so as to leave nothing for the tap to do at this portion of the thread. But, to accomplish this, it has to be done at the expense of the strength of the screw, as it has to be taken deeper to allow for the clearance between the flat crest and rounded root, and there would seem to be a solution to the point raised by your correspondent.

Regarding the other elements of the screw, I notice they have adopted the 60-degree angle, presumably on account of the possibility of originating equilateral triangles. This is undoubtedly an advantage for laboratory purposes, but is it easier to obtain 60 degrees than 55 degrees on a screw thread in practice? I very much doubt it. The variation in screw-cutting gages, for instance, for 60-degree threads is just as much as in those for 55 degrees.

The principle of making a clearance at the crest and root of the screw and nut is undoubtedly good practice, as this is the least important feature of a screw, but it seems to be carried to excess in the international thread. The size of a screw should never be determined by the outside diameter, a practice all too common in this country, but the denominating factors should be the pitch and the diameter on the slopes, which are inseparable in point of effect upon the size of the screw, as a little consideration will show.

On the whole, I cannot see in the international thread any improvement on the Whitworth, and, indeed, it would seem that I am not alone in that opinion, as there has not been what you would call a rush to adopt it. The Whitworth thread has been freely adopted among users of the metric system, and, if they are wise, they will retain it. J. E. STORY.

Warrington, England.

Grinding Rigs for Gas Engine Cylinders.

I have found, what I suppose everyone has who has had much to do with gas engines, that the finish and truth of the cylinder bore, piston and rings should be the very best possible. To attain this perfection I have designed and made for my own use two different rigs to grind the bore of cylinders. Fig. 1 shows a rig for the lathe that does the work well. The drawing is not to scale, but shows the idea, and any machinist can work out the details. *A* is a chuck which centers and holds one end of the cylinder, the other end being centered in the revolving steady rest *B*. *C* is the revolving part of rest carrying the four jaws *D*, which center and hold that end of the cylinder. *E* is a gray-iron casting that bolts to the cross slide of the carriage and has a gib under the bar *F* bolted to the carriage. When set for the cut the gib can be set up, making all rigid. The casting *E* has through its center, running in bearings, a shaft carrying an emery, corundum or carborundum wheel at one end and a driving pulley at the other. *G* is the end of a casting from the same pattern as *E*. The end is counter-bored to receive a machinery-steel piece slotted across the face to receive a square piece of tool steel. A set-screw holds the end piece from turning and a long steel bolt with a hole at one end and a nut at the other holds the cutting tool secured. This is used for boring. Fig. 2 shows a grinding bar to use between the centers of the lathe when the work is secured to the carriage and bored with a boring bar. It consists mainly of a gray-iron casting *A* with a driver fitted to it; the larger part is cored out and has a flange at the end. The core cutting through at one side in the middle, as shown, allows the grinding wheel to project. This casting is bored and the flange finished all over and then secured by three solid studs to another flange carrying a short shaft. Of course this short shaft should be re-centered and finished in perfect alinement after the studs are fitted. This shaft carries a pulley running loose, to which is secured an internal gear *B*, which drives a rawhide pinion secured to the shaft of the pulley *C*, a belt from which drives the grinding arbor. A larger view of the flange of *A* shows the means for adjusting the grinding wheel. A casting *D* is turned to fit nicely the bore in *A*. *D* is bored eccentrically to receive a casting *E*, which carries in proper bearings the grinding-wheel arbor. These castings are made in skeleton form to save weight as much as possible. A steel piece *F* is fastened to the flange and in it slides a steel piece *G* that fits into a counter bore in *E*, the grinding arbor passing through it. A tangent screw is provided for fine adjustment. The construction and use of it is too obvious to need any further description. A bearing *H* is secured to the bed of the lathe and adjusted to relieve the center of any belt pull. J. S. ROUNCE.

Ellsworth Wis.

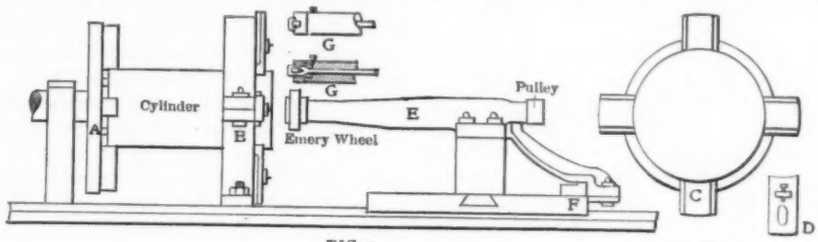


FIG. 1

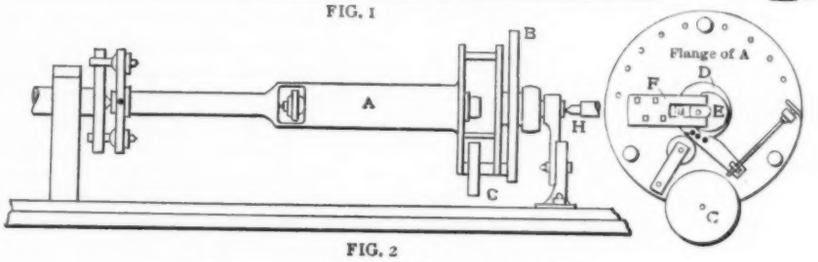


FIG. 2

GRINDING RIGS FOR GAS ENGINE CYLINDERS.

Systematic Economy in Making Drawings.

I was very much interested in G. F. Summers' article on Systematic Economy in Making Drawings at page 546. While it is true that the time employed on shop drawings should be cut down to the lowest limit consistent with making drawings that can be easily understood by the average machine hand, this rule does not hold good for all classes of work, and the statement should therefore be qualified, as in its present form it is apt to prove misleading to the uninitiated. Take, for instance, the case of the concern by which I am employed. Ninety per cent. of the drawings made are for what we call outside work, that is, building, location and machinery setting plans for the installation and erection of machinery sent out and for building the different houses used in the system. These drawings are also largely used by the salesmen in selling the goods and it is evident that work which would be plenty good enough for the shop would not do at all for this purpose. In the first place it is essential that the drawings used by the salesmen present as neat an appearance as possible, and be, in a measure, a picture of the objects represented, that the prospective purchaser, who is not a mechanic, shall at once recognize the different machines. Again, many of the outfits sold are erected, and the houses built by the purchasers themselves. To enable this to be done with satisfactory results the drawings have to be very ex-

plicit. I also find shade lines to be a necessity in this class of work.

Mr. Summers says that drawings are now produced mostly, "not by skilled men but by cheap labor," yet in the last paragraph of his article he asserts dogmatically that drawings should not be checked as it weakens the draftsman and costs money. These two assertions considered in conjunction will tend to add somewhat to the gayety of the profession.

Judging, from the attention given by F. W. McCardle in his article System in the Drawing Office to the subject of the care of sketches and data sheets, that others beside myself have had troubles of their own in this connection, it may prove of interest to your readers if I explain the simple method by which I take care of sketches and data sheets, i.e. by the loose-leaf system. The sheets are held in a clip on a board of convenient size for sketching and when filled in are filed in a loose-leaf binder with alphabetical index. The sheet is then available for reference at all times. Horizontal and vertical ruling is sometimes very convenient in drawing parallel lines and making sketches to approximate scale, but the lines should be preferably very thin and faint.

J. MELANCON.

Turret Lathe Cutters and Bars.

Since the advent of large turret lathes there has not been any great improvement in boring-bars and cutters. Most concerns still use the bar and cutter shown

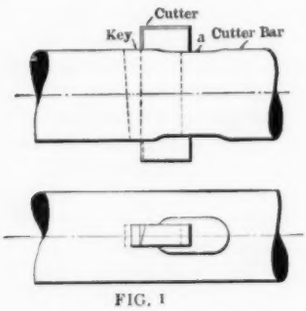


FIG. 1

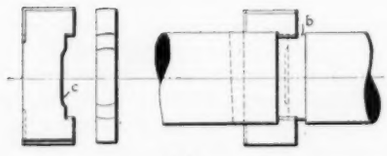


FIG. 2

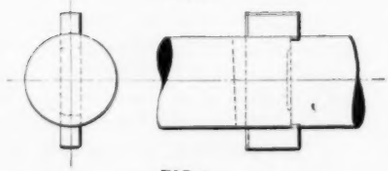


FIG. 3

TURRET LATHE CUTTERS AND BARS.

in Fig. 1. This bar is milled off on two sides, and the cutter is milled to fit, allowing a very small taper at *a* for a seat for the cutter.

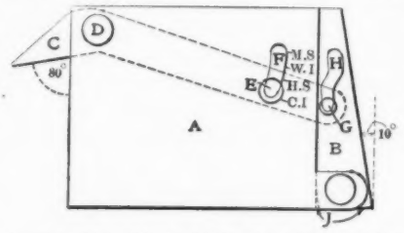
Fig. 2 is an improvement, inasmuch as the bar is turned at *b* (slightly tapered) on centers, thereby insuring a central position of the cutter much easier than by milling. The cutter is bored out in a special fixture on the lathe to suit the bar, and recessed at *c* to insure a perfect seat when the key is driven in.

Fig. 3 is similar to Fig. 2, except that the bar is not recessed, the cutter being bored standard to fit the bar.

I. N. QUIRE.

Adjustable Angle Gage for Lathe Tools.

Reading the article at page 438 on Osborn's File and Twist Drill Factories, and seeing the gages with the recommen-



ADJUSTABLE ANGLE GAGE FOR LATHE TOOLS.

ded angles for tools of high-speed steel, set me thinking of making a universal gage with the result herewith depicted. Referring to the drawing, the main plate *A* in a piece of 3/32-inch sheet steel on the bottom right corner of which is a lug. This lug is filed away at the back to allow the clearance-angle leaf *B* which is 3/64 inch thick, to lie flush with the back of plate *A*. The rake-angle arm *C* is also 3/64 inch thick and is pivoted to *A* by means of a rivet *D* and washer at the back. Fixed to *C* is a knob *E* which projects through and is free to move in the slot *F*, and at the end of *C* is a shouldered rivet *G* working in slot *H* in the leaf *B* which is pivoted at *I*. As the gage is normally, the rake arm shows 80 degrees and the clearance leaf 10 degrees. Now, if the knob *E* is moved to the index marked "H.S." the rake angle will be 75 degrees and the clearance will become 3 degrees, because of the rivet *G* forcing the leaf *B* outward. In moving the knob to "W, I." and "M.S." the rake angle will become 70 and 65 degrees respectively, but the clearance will remain 5 degrees in each case. To form the slot *H* correctly, I finished the gage as far as fixing *B* and *C* to *A*, then setting *C* to 80 degrees, I drilled a hole through it and also *A* at the position occupied by *E*. At the end I drilled another hole through *C* and *B*, then set *C* to 75 and *B* to 3 degrees, clamped them and drilled holes in *B* and *A*, using the holes in *C* for correct location. The operation was repeated for each pair of angles, after which the holes were opened into slots, care being taken to keep the slots the same width all along. Afterward the knob and rivet were fitted. The bottom of *B* should be cleared slightly as shown at *J* so that it will not project below the bottom edge of *A*.

The overall dimensions of the gage I have made is 1½ by 2 inches. It is therefore a convenient size and no doubt will prove very useful.

London, Eng. W. MADDISON.

Textile Rolls.

In textile work there are used a large number of carrier rolls for the cloth, made in varying lengths to suit the conditions, but generally of small diameter so as to take up as little room and be as light in weight as possible. These rolls are generally made from solid wood with iron journals, or from brass tubing with iron heads and journals.

I once had an order come in for 70 brass-tube rolls, to be finished 3 inches in diameter and 92 inches long on the face, with gray-iron heads and machine-steel journals. After the stock was purchased, it was decided that these rolls would not be stiff enough to stand up to the work they were designed to do, and rather than go to the expense of ordering heavier material, I decided to force a whitewood center into the tubes, leaving it just short enough to allow the heads to force into place. This was done, and the result was all that could be desired, as the rolls were satisfactory in every respect.

In a cotton mill shop where I once was, large quantities of small wood rolls were required for ring spinning frames, known as "clearer rolls." These were about ¾ inch in diameter and 18 or 20 inches long, with journals made of pieces of 3/16-inch wire rod driven in each end. They were then wound spirally with 8-ounce duck laid on in hot glue. Because of the large number used and the small diameter of the roll, it was necessary to make a special machine for turning these in long rods

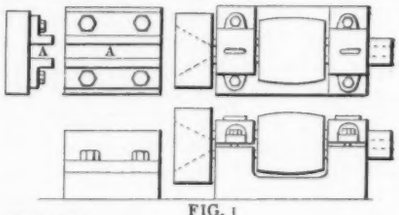


FIG. 1

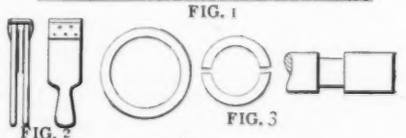


FIG. 3

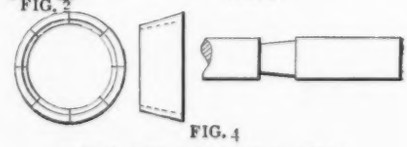


FIG. 4

ACCESSORIES FOR TEXTILE ROLLS.

from square stock, in order to reduce the cost of making. Several attempts were made before we got one that was successful, but the final result was about like Fig. 1. The square rods were held from

turning at *A* between the two angle castings, while being fed into the cutter-head of the machine. The spindle and head were made in one piece from soft steel and a 7/8-inch hole drilled through the spindle from end to end. At the cutter-head this hole was tapered out as shown by the dotted lines, and the head slotted for two cutters, which were fastened on with cap screws. This head was run about 3000 revolutions per minute on rough square stock ripped to size on the circular saw. Just before the last end of the square rod would leave the angle irons a grip clamp Fig. 2, lined with emery cloth, would be placed on the round rod at the delivery end of the spindle to keep the work from turning with the head. This machine worked nicely and gave good finished rods, which could then be cut to the length desired. Different spindles were afterward made for this machine so that one-inch lease rods for looms and other sizes could also be turned.

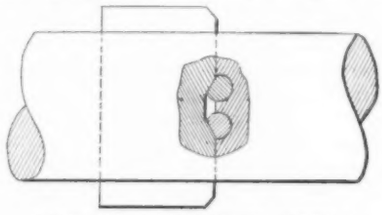
In the manufacture of cotton, husk or paper rolls, heads of either gray iron or steel are used, and as many tons pressure are used to compress the material of which the roll is made, the fastening or lock ring as it is called, must be made to hold very securely or there is apt to be something doing. Because of the low tensile strength of gray iron, heads of this material are invariably fastened with what is known as the "Yankee" ring, which is shown at Fig. 3. This is to distinguish it from the tapered or "English" ring shown at Fig. 4. With the Yankee ring, the shaft has a slot cut around it 3/8 inch deep and 1 1/16 inch wider than the inside ring, which is bored to fit the groove in the shaft, finished all over and cut in half with a metal saw. The outside ring is faced on one side and bored a shrinking fit for the inside ring when in place. The English ring is bored at one angle and turned at another, so that the ring is about twice as thick at the large end as at the small end. After the rings are finished all over, the steel head is bored to fit the outside taper, leaving the hole small enough so the ring will extend about 1 1/16 inch above the faced surface of the head. When the presses are released the head will be forced upon the ring so tightly that the edge of the ring and the face of the head will be about even, and less stock will have to be turned off to make a finished job. The groove in the shaft is tapered to fit the inside of the ring, and about the same allowance is left for slip at the large end. The ring is generally cut into eight pieces, using a circular metal saw. These pieces are placed in the slot and held by a small string until the press is released, when the head will wedge up tight. The principal advantage of this style of ring is the facility with which it may be removed when making repairs. They are considerably more expensive to make, however, than are the steel heads. Both styles of rings are made from wrought-iron forgings.

L. L. ARNOLD.

Fastening Air-hardening Cutters in a Boring Bar.

After reading Mr. Bell's article at page 613 it struck me that the way shown in the sketch would be an easy way out of the difficulties mentioned.

Two pins are used, made of straight round stock, fitting two straight drilled holes in the bar. The pins have flats, bearing against the ground straight surfaces of the cutter, as shown. The pins will turn and adjust themselves and a good bearing is assured without much trouble. A disadvantage is that it depends upon the operator to bring the cutter central; on the other hand it may come in handy to move the cutter one way a little to finish a hole larger. The pinholes should be close together and at the same distance from the center of the bar to minimize the danger of springing the bar. In a long bar with slots for cutters in different places the two holes would probably weaken the bar too much.

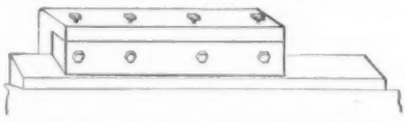


FASTENING AIR-HARDENED CUTTERS.

J. SCHURING.

The Place for Adjusting Screws on Gibs.

In using a gib of the form shown in the cut, where is the proper place for the adjusting screws? It is the common practice to place them directly opposite the screws which hold the gib in place, causing the pressure to be applied at the weakest points of the gib. In a great many cases this is of no consequence, but in the case of machines subjected to severe usage, gibs frequently give out at this point. Most of the instances which have come under my observation have been on forging machinery, hammers, etc.



THE PLACE FOR THE ADJUSTING SCREW.

It may be that the proper remedy would be the strengthening of the gib, but it seems to me that if the screws were made to bear a little to one side of the holes the trouble would be overcome. One factory that I know of makes a practice of doing this on machinery they buy and on which they have had trouble, and seemingly with good success. F. F. F.

The College Shop.

Referring to Professor Kimball's article at page 499, after reading the accompanying editorial, I hesitated about saying anything about it, but I am intensely interested in this matter of education, and some of my experience has led me to feel that there is something more to be said. I have no quarrel with the article but the conditions which lead to such methods of instruction being necessary seem to me deplorable. It seems to me that, while manual dexterity is unnecessary to a student who wishes to become an engineer, he cannot be too well grounded in the multiplicity of shop processes. Did you ever try to do some simple thing which you have seen done time and time again but which you had never actually done yourself? Did you succeed? Take so simple a thing as laying a hardwood floor. You will see a carpenter put those long slim nails down with such thoughtless ease that you never dreamed how easily they would double up till you tried it. Fifteen minutes will teach you the trick and it will never be forgotten. Just so with shop work for an engineering student. There is almost nothing done in a shop that has not some hidden spring about it which if properly pressed will bring the job along all right but which will bring dismal failure if not rightly handled. From my own experience in pattern making and machine work I should say that there are from 300 to 400 distinct jobs which have peculiarities which an untrained person could not hope to deduce from the ordinary run of school exercises. Just so long as a student is without the knowledge of these kinks he is lame as regards any branch of engineering which depends on a machine shop to carry out its ideas.

A LEADER SHOULD KNOW HOW.

A number of years ago I was a machine shop foreman with 25 or 30 men under me. I had begun with two. Every new machine that was brought in I ran myself long enough and on a sufficient variety of work so that I knew its possibilities and its weaknesses. My men soon came to know that I knew about these things and when I told a man to put on more feed he didn't give me a long tale about the lack of power but he put it on. It is just so with an engineer. He must deal with men who are just as capable of sizing him up as he is of sizing them up. They will not work well for a man whom they do not respect. For them to respect a man he must be able and ready to lick them. In some shops this means a physical licking, in others only that the boss must be able to beat them on a job by his dexterity or his quickness to find a way to do it. You may say now that an engineering student doesn't expect to be a foreman. I tell you he is lucky if he can be for a while at least. Even after he has graduated from a foremanship his work is

not out of sight of those same eyes. He is judged in the same way and the work he has planned prospers or suffers just as these same men believe in his ability or distrust it. And if the workmen can look past the foreman at him, how about his immediate subordinates? Shop men sometimes, graduates of other schools more often, they size him up the same way. Some men can pick up these points intuitively. They seem to grasp more from seeing work done than others, but they are scarce.

Since these things are taught in few college shops most men have to get them by hard knocks. Take a single example. In how many college shops is a student taught how to put a piece of work on a planer without wind if the piece will spring perceptibly of its own weight? Take a lathe bed. How many college graduates could put one on a planer so that it would have a chance of coming off straight? And yet it is hard to think of a branch of mechanical engineering in which the student will not sooner or later have to know something of just such things.

LEARNING BY DOING.

What change could be made in college shops that would help this matter? I would suggest for one thing that the laboratory method be followed out far enough so that the student, instead of being taken into a lecture room and shown precisely what to do and when to do it for each individual operation would be given something to do, have to submit an outline or synopsis of the method he thinks will do it to his instructor and then go ahead and blunder through it, being helped only when he is absolutely in a hole, and then mostly by a question which will set him thinking in the right channel rather than by showing. The reason why I should have the student submit a statement of what he intends to do is that the instructor may head him off if he plans to hang himself or destroy too much machinery or anything of that kind. My plan would also involve a greater number of exercises or jobs, mostly such as may be completed in a very short time. I would also have a few jobs where the student would first make one piece by ordinary job-shop methods and then carry through a lot of quite a number of pieces by the use of the best jigs and tools the college could afford. This would illustrate to him the difference between doing machine work and manufacturing, and illustrate it so forcibly that he would remember it.

THE PROPER EQUIPMENT.

Such a shop ought to have in it every variety of machine tool that its funds would provide. It is all well enough for a manual-training school to order all its lathes of one builder, but an engineering school ought not to do so. It ought to have no two of the same make until it had exhausted the list of available manufacturers. It ought to do commercial work to this extent that it should manufacture a line of machinery which would afford necessary exercises for the students. The remainder of the work, but no more, should be done by journeymen, so that the work which the student does do successfully may not be thrown away. Someone acquainted with college shops will say that to have journeymen finish up boy's work is like fitting a barrel to a bung hole, but it need not be quite so bad if the work given the student is carefully graded to suit his ability. This brings up Professor Kimball's remark: "The instruction given must be uniform; that is we must guard against one boy getting an excellent shop training and another little or none." I do not believe that Professor Kimball meant this to be taken literally. Possibly the conditions under which he labors are such that he has to make instruction uniform. If so it is unfortunate for the really bright boys for they must be held to the level of the poorest boys that will be allowed to pass examination time. To be sure his bright boys will get greater manual dexterity from having to go slow, but that is just the thing on which he and I firmly agree namely, that manual dexterity, in the shop at least, does not make an engineer. The further we get from the personal touch of instructor toward pupil, the further we are from the right ideal whether we do it on account of lack of facilities or lack of energy or through a desire to outshine other schools in point of numbers. What is wanted is a liberal and varied shop equipment and a corps of thoroughly trained practical instructors who are content to allow the student to find his own way to the greatest possible extent.

THE POSSIBILITIES OF INDIVIDUAL INSTRUCTION.

Someone will be sure to say that it is an impossibility for an instructor to take an ordinary sized class of boys and get anything out of them on the individual treatment plan. If anyone so thinking will write to me in care of the AMERICAN MACHINIST, I will prove to him conclusively that it is possible. I have done it with classes of from 25 to 50 students in drawing and machine design and one of my colleagues is doing the same thing in shop work. More than that, we are not giving preliminary work which is merely exercise work. We drop them right into the real thing. We make them think for themselves. We leave out all mystery. We tell them that the whole thing is too simple to be taught at all, and it is for them to find ways. We will not do anything for them until they have something to show us or at least propose. Then we will show them, but we have no time for those that will not help themselves. The effect on the student is a surprise to me. They come to us coddled by the preparatory school; they expect to be taught to swim with an instructor to hold up their heads and four others to guide their hands and feet. When they get dropped in and have to swim or drown it is astonishing how well they swim. After they get used to it they like it.

INSTRUCTOR.

A Method of Taking Inventory.

The annual inventory which I see is being discussed in your columns, is a job which is distasteful to nearly everybody, and there is too often an inclination to hurry it along "any way to get through." It is possible, however, to systematize the work and so divide it up, that the inventory may be taken rapidly, accurately and without being unduly irksome. I assume that the work is undertaken both for arriving at a valuation and for reference by the purchasing department, also for locating material on hand. If only the valuation is desired a part of the work as outlined could be omitted.

In the first place explicit typewritten instructions should be issued several days in advance so that the foreman, department heads, and others may post themselves as to their duties. Care should be exercised as the time approaches to have all material in convenient shape for counting, as this will greatly facilitate matters. Put as many at work counting in each department as will insure speedy completion of this work. Following the counters let competent men tag the material. The tags are perforated, the stub having space for quantity only, while the part to be detached has blanks for Kind of Material, Dimensions, Quantity, Department (or Building) Number, and in the case of partly finished material for Operations Performed. As machine operations are usually performed in a certain order it is usually sufficient to name the last operation performed which will indicate that previous operations have been performed. Another man familiar with the proper names of parts detaches the tags at the perforation, noting, as he does, that parts and material are properly described. Now let the foreman go carefully through to gather up any tags that have been missed (and there are pretty sure to be some), and the stubs will enable him to check the thoroughness of the work, for if a pile of material bears no stub it is evident that it has been overlooked.

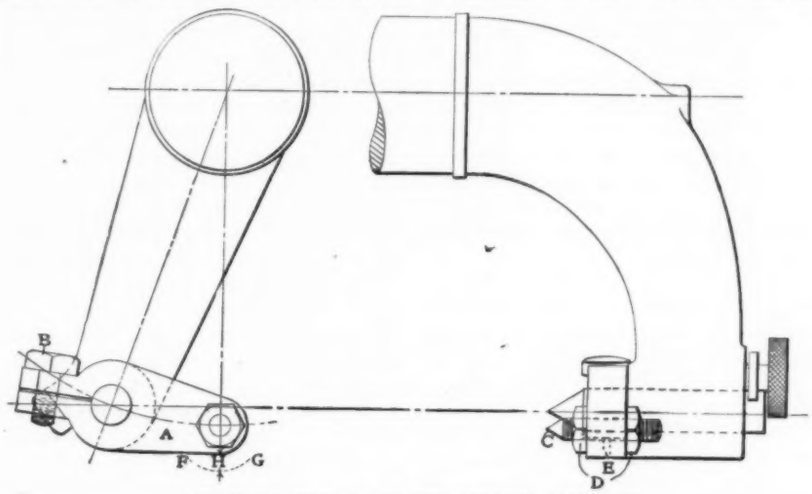
The tags are sent to the office where they are sorted, first as to general classifications, then as to kind of material, and finally as to size, etc., bringing all of one kind of material together regardless of location, except when in a different classification, e.g., raw material would be separate from partly finished work.

Sheets are provided for entering the figures from the tags and are arranged to be bound in a loose-leaf binder. Where several tags of one kind are from the

same department or building the total may be entered with the department or building number following to show where located. As fast as the sheets are filled they go to the purchasing department where materal is priced, then to the cost department for labor cost. Other clerks make the extensions, and after these are checked, the footings are made and checked. All that now remains to be done is to arrange the sheets, bind them and make up the summary, or the totals of each class, the sum of which is of course the grand total. F. F. F.

An Auxiliary Center for the Miller.

The accompanying drawing shows an attachment I devised and made for use on a No. 1 Brown & Sharpe universal milling machine. I frequently have small jobs to do that have to be milled with cutters of small diameter, the curves of the cutters forming the finish of shoulders, etc. As the majority of these jobs have to be held in the vise, special rigs being out of the question, I used to experience a good deal of trouble as the lower edge



AUXILIARY CENTER FOR THE MILLING MACHINE.

of the overhanging arm would not allow the vise to come up close enough to the cutter, so I had to run the cutter without support which caused a good deal of chattering until I hit on this idea. Referring to the drawing *A* is a machine-steel body of the shape shown, bored to fit snugly over the sliding center in the overhanging arm, and slit toward one end to allow tightening by means of the screw *B*. The narrower end of *A* is bored for a ½-inch hardened steel center *C* which is threaded at the ends for the adjusting nuts, *D*, the central portion being left plain, a pin *E* working in a spline cut in it prevents turning when it is adjusted. The dotted line *F G* shows the position the bottom of the overhanging arm itself would occupy. Therefore double the distance *H* is the amount the diameter of the cutter can be decreased to work to the same position relatively to the vise. In this particular case the distance *H* is ¼ inch, therefore a cutter 1 inch smaller in diameter can be used than with the ordinary arm. To adjust it, the sliding center is run out of the arm as far as it will go and the body *A* slipped over it and tightened by the screw *B* sufficiently to prevent it moving too freely. The arm is then moved about until the center *C* locates itself in its right position. The arm and the body are then both clamped tight. The pressure on the mandrel or cutter centers is adjusted by the nuts *D*.

Clapton, England. W. Maddison.

The Economy of Accurate Patterns.

Among the expenses of establishments making things of metal in which castings are used, there are very few in which the item of labor is not the greatest. Therefore anything that will tend to lessen the labor on an article will mean greater profits, and that I believe is the chief aim of most concerns. I think that one of the common causes of the high cost of many machine-shop products and one that is too little considered is that of practicing economy in the first cost of the patterns from which the machine is made. An hour more spent on a pattern very often means a saving of two in the foundry or machine shop, and while this hour is spent on the pattern but once, the saving is effected every time the pattern is molded or machined. Even if the saving in molding or machining is ten minutes each time, it does not take long to offset the hour spent on the pattern and then the saving becomes clear again. The molder gets results with less worry, and the machinist saves doing unnecessary work. I contend that the patternmaker has not completed a pattern unless he can tell how the molder can get it out of the sand after he has rammed it up. He may say: "The molder will get it out some way." So he will, even if he has to dig it out, but that is rather bad for the mold, and does not leave it in very good shape for a casting. There are many patterns sent to the foundry of which the maker cannot tell how to mold them. They will say that they are not molders, with which the molder will doubtless agree, and he may also add: "Neither is he a patternmaker." Patterns made to mold the simplest way and with enough stock for machining, but not too much, even if the first cost is high; are economical in the end.

Of course it does not pay to put useless time on a pattern that is to be used for but one or two castings, but the sizes can be right even if it gets no sandpaper or varnish. Patterns with as few loose pieces as possible have fewer to get lost, but the fact must not be overlooked that it is often cheaper for the patternmaker to make the parting than it is for the molder to do it. The more the patternmaker knows of partings and where they should be, the more he works to the molder's advantage as well as to his own, for he will often save himself doing the job a second time, as well as gain the good will of the molder. Vent holes are often left out of core boxes because many patternmakers do not know where to put them, or what they are for. Of course the coremaker can drive a nail through or run a hot iron in it, but that is both expensive and destructive. All patternmakers, or those who make patterns, should know that the vents are always taken out through the part of the core that lies in the core prints, and that the vent holes should be bored in the side of core box so that the vent rods will go through the opening in the casting.

Lack of knowledge of what a pattern is to be used for often causes unnecessary time to be spent in being accurate, when a slight variation would be permissible. I think too little information is generally furnished on this point by the drafting room or customer. It is a waste of good money to make templets for much work that should be worked by the eye. A good eye is one of the patternmaker's most valuable tools. I recall what my first boss once said to me when I had the job of sorting out a lot of screws that were badly mixed, and to get them right was measuring nearly every one, and he came along and saw me at it. He stopped to look at me a few minutes and then said: "Sonny, you must not do that, it takes too much time and the screws are not worth the time it takes to get them sorted; you must have a mechanical eye and tell the size by looking at it." I think that the cultivation of the eye to determine sizes and shapes is very much neglected, for the eyes can be trained to do measuring.

How often do we hear the expression, "That's good enough." But a pattern is not good enough unless it will come out of the sand, even if it has three coats of varnish on it, and unless the molder can make it without having to patch his mold. If the core does not fit it costs

time to make it do so, and, moreover, the core is not likely to come where it should. Part the pattern so that the molder does not have a lot of pieces to draw, that saves his time for other work. If a casting comes out poor on account of a patched mold or a core that is out of place, even if it isn't scrapped, the machinist will have to do more work on it than he should to get it right, all of which might be saved were the pattern more accurate.

With the greatest care errors will happen; one will sometimes measure a thing wrong or get a wrong total when adding dimensions, even making the same error a second or third time. For this reason I have patterns checked by a different man from the one that made them, as two different men are not likely to make the same error; what one fails to see the other is likely to discover. The essentials of a good pattern are: All dimensions must be right; part it if necessary; make it so the molder can draw it; use cores where the lift would be deep; make the cores so they will go into the spaces the prints leave; make it rough for few castings; make it smooth and strong for many castings.

Don't put a dollar's worth of time on a fifty-cent job, and then wonder why the boss kicks. J. L. GARD.

The New Tariff in British India.

From the new tariff for British India the following items are taken as being of interest to such readers of the AMERICAN MACHINIST as are concerned with exports to that country.

Hardware and cutlery, including ironmongery and plated ware, also machines, tools and implements to be worked by manual or hand labor. 5 per cent. ad valorem.

Water-lifts, sugar-mills, oil-presses and parts, and any other machines or parts used in the processes of husbandry, or for the preparation of articles of husbandry for use and sale, upon exemption by the Governor General. Free.

Winnowers, threshers, mowing and reaping machines, elevators, seed-cutters, chaff-cutters and other agricultural machinery, when constructed so that they can be worked by animal or manual power. Free.

Dairy appliances to be worked by manual or animal power. Free.

Machinery for use in manufacturing cotton. Free.

Machinery, namely, prime-movers and component parts thereof; also including locomotives and portable engines, steam rollers, fire engines and other machines in which the prime mover is not separable from the operative parts. Free.

Machinery and component parts thereof, meaning machines or sets of machines to be worked by electric, steam, water, fire or other power not being manual or animal labor, or which, before being brought into use, require to be fixed with reference to other moving parts, and including beltings of all materials for driving machinery. Free.

Only such articles are to be admitted as component parts of machinery as are indispensable for the working of the machinery and are, owing to their shape or other special quality, not adapted for any other purpose.

Motor cars for carrying goods. Free.

Instruments, apparatus and appliances, and parts thereof; computing, electric, electric lighting, galvanic, surveying, telegraphic, telephonic, except when imported by a railway, or as part of personal baggage. 5 per cent. ad. valorem.

Railway materials of all kinds, when imported by and under the orders of a railway company. Free.

Washington, D. C. A. F. TENNILLE.

Census of Iron and Steel Industries.

The preliminary figures for the steel works and rolling mills of the United States, covering these industries for the year 1904, forming, as they will, a part of the Census of Manufactures for 1905, show that there has been an increase in the industry as compared with similar returns for the year 1900. For instance, in the latter year the number of establishments reported was 438 with a capital of $429,960,043; in 1904 the number had decreased to 415 or 5.3 per cent., but the capital invested had increased to $760,182,310 or 76.8 per cent.

During the same time the number of salaried employees carried on the pay rolls had increased from 7442 to 14,330, or 92.6 per cent., and their wages had been increased from $9,421,868 to $17,861,495, or 89.6 per cent.

In addition to the salaried employees above mentioned there were carried on the pay rolls in 1900 183,023 wage-earners to whom was paid $102,238,692; in 1904 this number had been increased to 207,563, or 13.4 per cent. and the wages paid to $122,491,993, or 19.8 per cent. so that here as elsewhere throughout the manufacturing world, it can easily be seen that there has been a decided increase in wages demanded and paid.

The item of miscellaneous expense has increased from $24,795,663 in 1900 to $37,373,471 in 1904, or 50.7 per cent.

It will also be found from an examination of the following comparisons that there have been material increases in many other directions.

Consul U. J. Ledoux, of Prague, has discovered something which he considers new, and contributes to the *Daily Consular and Trade Reports* an account of what he calls the use of "overheated" steam in locomotives. Our readers will recognize this as the attempt of a non-technical man to translate superheated steam, which, of course, those who are interested in the subject have heard considerable about, and probably will not be able to derive much information concerning it from the source named. But the term "overheated steam" is certainly new and interesting, and we have heard of engineers having considerable trouble with packing and with lubrication and who would probably be ready to say that some superheated steam is really overheated.

Free Alcohol.

The Committee of Manufacturers, formed to assist in securing cheaper alcohol for industrial purposes, sends us a copy of the bill recently enacted for the purpose, and the statement is made that the success of the work has been largely due to securing the active co-operation of the farmers of the country. "It was only through bringing the influence of the farmers of the entire country to bear directly on their senators and representatives, that the committee was able to overcome the opposition of the antagonistic interests which have so long prevented action by Congress." The further statement is made that this committee will preserve its organization with a view to protecting the interests of the manufacturers affected by this legislation in matters connected with the administration of the law; and this, we think, is an excellent idea. We note, among other members of the committee, the following, who are well known to our readers: Walter J. Green, of the Savage Arms Company, Utica, N. Y.; H. A. Lozier, Jr., president of the Lozier Motor Company, New York; J. F. Bunting, chairman of the Committee on Legislation, of the National Association of Engine and Boat Manufacturers, of New York; C. T. Hughes, of the General Electric Company; Henry R. Towne, president of the Yale & Towne Manufacturing Company, of New York; Timothy L. Woodruff, president of the Smith Premier Typewriter Company, of Syracuse, N. Y.; John J. Amory, president of the Gas Engine and Power Company, and of Charles L. Seabury & Co., of New York. Other members of the committee represent various lines of manufacture, including pianos, furniture and hats.

An official of the American Locomotive Company has been summoned as witness in a somewhat curious way. The Illinois Central Railway had claimed that it could not furnish a certain coal company with sufficient coal cars to handle its business from 1899 to 1905, and among other reasons for this it is claimed that during the period referred to it was not practicable to secure locomotives to handle the traffic. The coal company claims the contrary, and has brought suit. The official of the American Locomotive Company referred to testified on this point and as to whether it would have been practicable

for the road to have secured the locomotives during the period named; the presumption being that if the locomotives could have been secured, it was the duty of the common carrier to secure them and and to handle the business of all the concerns depending upon it as a highway to their markets.

Standard Screw Threads for Electrical Apparatus.

BY E. R. DOUGLASS.

The U. S. system of screw threads is in practically universal use in this country. The simplification attending its general use has undoubtedly been the cause of very great economies. For most purposes it is well adapted. For certain kinds of work, however, a finer pitch than the U. S. standard is desirable. Parts subject to continued vibration which work loose when held by U. S. standard screws are found to remain tight if screws with finer threads be substituted.

In electrical connections on switchboards, etc., finer threads than the U. S. standard have been found especially desirable.

In comparing the "standards" of different companies in the use of these finer threads, great disparity is at once evident. The table herewith shows present conditions, and also gives my recommendations as to a proposed uniform standard. For comparison, the U. S. standard pitches and those of the pipe thread system are also given.

The columns headed *A B*, etc., represent the actual "standards" of as many different manufacturing companies in the United States, all at present doing active business.

Manufacturer *A* has simply doubled the number of threads per inch of the U. S. standard screws. This is simple and easily remembered, but it gives pitches which on the smaller sizes are too fine for copper studs. On sizes of 3-inch and above the threads would be coarser than desirable.

Manufacturer *G* has adopted a uniform pitch of 12 threads per inch all the way from ½ inch up.

Manufacturer *J* has adopted the pipe-thread pitches on most of his sizes, but has had to interpolate some new sizes. The lists of manufacturers *C, D, E, F, H, I*, and *L*, are curiously irregular. On any given size also the different makers show little uniformity.

Diameter of Stud	U.S. Standard Threads	FINE THREADS — Various Present "Standards"											Pipe Threads			Diameter of Stud	Fine Pitches recommended as Standard
		A	B	C	D	E	F	G	H	I	J	K	L	Nominal Size	Outside Diameter	No. Threads		
¼	20	40	20		50	24	20		20		24	20	20				¼	20
5/16	18	36			18		18		18		18	18					5/16	18
⅜	16	32	16	16	16	16	16		16				16				⅜	16
7/16	14	28					18										7/16	16
½	13	24	16	13	13	20		12	20	13	18	13	12	¼	0.54	18	½	16
9/16	12	24					15	12									9/16	16
⅝	11	22	16	11	11	20	18	12	20		18	11	11	⅜	0.67	18	⅝	16
11/16	11	22						12									11/16	16
¾	10	20	16		12	20	18	12	16	10		10		½	0.81	14	¾	16
13/16	10	20			12		18	12									13/16	16
⅞	9	18	16		12	18	18	12			14	9	12				⅞	16
15/16	9	18			12			12			14						15/16	16
1	8	16		14	12	16	16	12		8	11½	8		⅞	1.05	14	1	16
1⅛	7	14	12		12	16	16	12	16	14	11½	7		1	1.31	11½	1⅛	14
1¼	7	14	12	14	12	14	16	12	16		11½	7					1¼	14
1⅜	6	12	12		12	12	16	12		14							1⅜	12
1½	6	12		14	12	11		12						1¼	1.66	11½	1½	12
1⅝	5½	11			12			12		12				1½	1.90	11½	1⅝	12
1¾	5	10		12	12			12									1¾	12
2	4½	9		12	12			12		10							2	12
2¼	4½	9		12	12			12		10				2	2.37	11½	2¼	12
2½	4	8		12	12			12			8						2½	8
2¾	4	8												2½	2.87	8	2¾	8
3	3½													3	3.5	8	3	8
3½	3½																3½	8
3¾	3													3½	4	8	3¾	8
4	3																4	8

TABLE SHOWING THREADS PER INCH IN PRES ENT AND PROPOSED SCREW STANDARDS FOR ELECTRICAL APPARATUS.

The series recommended is shown in the last column of the table, and follows the U. S. pitches on the first three sizes. It then runs with but two changes to the 2¾-inch size, where it has become double the U. S. standard, 8 threads per inch, and so remains for sizes above that.

I would like to invite a discussion on this subject from those who may be interested, with the object of ultimately reaching a definite standard, if that be possible.

In Appleton's *Booklovers' Magazine*, Julian Hawthorne attempts to tell the world how machinery has degraded and is degrading literature. His idea, as near as we can get at it, is that as books, paper, print and binding are now manufactured by machinery, instead of the work being done by hand, as was formerly the case, this has some sort of a reflex action upon authors, and exerts a very demoralizing influence upon them, so that they are impelled to write books by machinery, so to speak. Then from this he concludes that they are also moved to copy each other's style, so that when one successful book appears, a brood of others, as near like it as their authors can make them, will also appear, and all this, according to Mr. Hawthorne, is not due to the general strenuousness of the times and to the intense and growing struggle for "success," but is due to the invention construction and use of machinery, all of which we consider to be just plain tommyrot.

The Marine Steam Turbine in Great Britain.

Whatever may be the result of the experiments which are being made with the application of the steam turbine to large ocean steamships, the experience with vessels of the size of river and sound steamers appears to have been satisfactory. *Engineering* refers to the growing use in England of the turbine upon vessels of the latter type. It was on the passenger service on the estuary of the Clyde that the Parsons steam turbine had its first commercial application, following upon its success in the experimental torpedo boat "Turbinia." The "King Edward" was the pioneer in this service, followed by the "Queen Alexandra." This year the Caledonian Railway Company has had built by William Denny & Bros., Dumbarton, a triple-screw turbine steamer, the "Duchess of Argyll," for the Clyde service (the sixteenth turbine boat by these builders); this boat has made a mean speed of 21.11 knots; the Glasgow & Southwestern Railway Company has had a somewhat similar one, the "Atalanta," built by John Brown & Co. and equipped with the complete turbine set which was built by Messrs. Brown & Co. as an experiment previous to the design of the big turbines for the "Carmania" and "Lusitania" of the Cunard Line. The arrangement of the "Atalanta's" turbines, as is usual in steamers of this size, is to have a high-pressure turbine on the center shaft and one low pressure on each of the wing shafts. The latter also each have a reversing turbine at each end. In addition, a new turbine steamer with a speed of 22 knots has been put upon the daylight service to Ireland, and turbine steamers are running on the Mersey and the Thames. The "Kingfisher," a steamer for excursion service from London to Boulogne, was built to attain a 20-knot speed and made 21.43 knots when tried. She is 275 feet long, 32 feet beam and has the usual arrangement of three turbines. In five years, therefore the turbine has made its appearance on all the principal rivers and the channel service.

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Some Public Questions Affecting Manufactures.

It may be remembered that, some time ago, we commented upon the curious circumstance that certain American railroads had been asked to transport steel rails for export at especially low rates so that a price could be made for these rails in the foreign country to which they were to be shipped, which price was to be considerably lower than the railroad had to pay for its own rails over which the shipments of these exported rails were to be made.

The complaisancy of prominent railway officials in the face of a condition of that kind seemed a little strange, and it is perhaps explained, or at least considerable light thrown upon it, by the most recent revelations regarding the position of Pennsylvania railroad officials with regard to the ownership of stock in various steel manufacturing concerns; it having been stated by Mr. Cassatt, president of the road referred to, in effect that, he, buying all the rails for his road, really stands in the position of being at both ends of the bargain. That is to say, he buys the rails for the Pennsylvania railroad, and at the same time he is the seller of the rails on his own account, or on the account of another company in which he is largely interested.

Where the other stockholders in this company and competitors of it, and where the general public comes in in an arrangement of this kind was not stated, and it is a little difficult to perceive where they come in at all, so far as equal treatment by this important common carrier is concerned.

In this connection there is the conviction of the Burlington railroad of making discriminating rates or rebates in favor of the Chicago packers, for which it is said the road may be fined $80,000.

With such things as this evidently in mind, Dr. Butler, president of Columbia University, New York, in an address at the recent commencement exercises, expressed in plain terms his belief that we are entering upon a period of social and economic, and possibly of political reconstruction. Referring to the fact that many of our most conservative citizens had become convinced and were freely saying that some change in conditions must be brought about, he took care to make it clear that he did not think the way to right these wrongs is in the direction of socialism, but on the contrary expressed his faith in principles, which had become settled in the process of evolution, and which he stated as "civil and industrial liberty, private property, and the inviolability of contract." "Upon these as a corner stone, rests," he said, "what we know today as civilized human society." In this statement thoughtful people will generally agree with Dr. Butler, but the existence of monopolies is not in accordance with these principles, and an increasing number of the most conservative citizens are coming to perceive that every form of monopoly and of special privilege must be done away with, so that there shall be what President Roosevelt calls a square deal for every man, and an exactly equal chance for him to be successful in life in proportion to his ability, his industry, and his willingness to exercise self restraint.

Dr. Butler's advice to college men that they meet the new problems tranquilly; that they avoid losing balance, poise, and self control while they carefully consider the best course to pursue is of course good advice for those whose education has been gained in machine shops and business offices as well.

In this connection again comes up a question with respect to the money which has been set aside by Andrew Carnegie, the income from which is devoted to the pensioning of supernnuated college professors. Professors in technical schools participate in this and Dr. Pritchard, of M. I. T., is at the head of the board of administration. We understand that there is some dissatisfaction with the basis of division of these funds, and some people are looking far into the future with respect to the effect of their distribution. The capital of this fund consists of $10,000,000 of United States Steel bonds, the real value of which, according to the public testimony of Mr. Schwab, rests ultimately upon the value of a practical monopoly of certain iron ores, coking coal, railroads, etc., these monopolies constituting, according to the testimony referred to, by far the major portion of the value of the bonds and stocks of the U. S. Steel Corporation. It has been demonstrated and is constantly being demonstrated that the possession of such monopolies by any one company or group of companies is contrary to public interest; that instead of developing and encouraging manufactures, it restricts manufactures, and prevents the securing of a square deal for every citizen. If, as Dr. Butler plainly intimates, all such monopolies are liable to be destroyed within the next few years, what will be the effect upon the distribution of the funds derived from the bonds referred to? It is easily possible that questions arising with respect to this matter in the near future will be considerably more important and more urgent than those which deal simply with the relative amounts to be received by different professors.

As a matter of fact, should not education be placed upon such a basis that educators would receive during their active years a sufficient recompense for their labor, to enable them to provide for the disabilities of old age? And if that can be done, it would seem to be in all respects much the better way of supporting educators.

New Publications.

"The Battles of Labor." By Carroll D. Wright. 220 4⅜x7¼-inch pages. George W. Jacobs & Co., Philadelphia.

This volume contains the William Levi Bull lectures at the Philadelphia Divinity School for 1896. It is absolutely dispassionate and will be found to be of the first order of interest. The lectures are primarily historical, and show that the battles of labor are no new thing, but that, on the contrary, they are as old as civilization itself, trade unions having "existed since history took any account of human affairs," thirty-five such being now known to have been in existence at one time under the law of Constantine. The historical account begins with the Exodus under Moses which the author considers "the greatest strike that has been recorded" and coming down to more recent times we are told that the building trades "certainly held their organization through a period of six hundred years at Rome and nearly as many in Attica and other parts of Greece." Of the unions of mediæval times we are told that they had many features "coincident with those with which we are entirely familiar. They fixed the hours and the days for working; they allowed or restricted output by regulating the size of articles to be made, the quality of the stuffs used in their manufacture and even the price at which they were to be sold." Coming down to more modern times the author asserts that "It is reasonably certain that a strike occurred among the bakers of New York city as early as 1741" and that there was also a series of strikes among the boot and shoe makers of Philadelphia beginning in 1796, while in 1809 there was a strike among the cordwainers of New York, in which the terms strike and scab were first used. In 1835 "five hundred mechanics in Boston struck for the ten-hour system, and this was the case in twenty mills in Paterson, New Jersey." From 1741 to the beginning of the great strike era in 1880, the author has identified 1491 strikes and lockouts in this country. The greatest number of strikes in any one year occurred in 1890, this number being 1833. During the period from 1891 to 1900 inclusive, 117,509 establishments were involved in strikes, 6,105,694 employees being thrown out of employment, and during this same period there were 1005 lockouts involving 10,000 establishments and throwing over 1,000,000 people out of employment. The wage loss during these twenty years amounted to nearly $258,000,000, while the money spent by the organization, assisting their members was over $16,000,000, the losses of the employers being set at nearly $132,000,000. The author has worked out the figures for 5443 strikes and has found the average wages lost per employee to have been $20.42, and the average daily wage gained per employee 27 cents, the result being that, on the average, 76 days would be required to recoup the loss occasioned by the strike.

Regarding the attitude of the courts and legislatures we are told that "up to the early part of the Nineteenth Century a strike was considered a conspiracy," and in the early part of that century juries usually found the indicted parties guilty. At present "the courts everywhere take this view that men have a right to associate together peaceably to make their demands and quit the work of their employers," some judges however taking the ground "that there is no such thing as peaceable picketing to prevent scabs, as they are called, or non-union men from entering the works of the employer of the strikers."

The great strike of 1877 on the Pennsylvania railroad, the telegraphers' strike of 1883, the strikes on the Southwestern system of railways in 1885-6 and at the Homestead steel works in 1892, the Pullman strike of 1894, the anthracite coal strikes of 1900 and 1902 and the Coorado strikes of 1903 are reviewed at considerable length.

While unsparing in his criticism of the excesses of trade unions, and especially of the boycott, the author is, at bottom, in sympathy with them, saying: "I think all men, or nearly all men, understand the union itself is a benefit. This is certainly true of England and the employers of that country would not have the unions crushed if they could. Their development has been one of real, though slow, improvement in the relation between employer and employee. All combinations of men, however, no matter in what direction they are made or what purposes they propose to achieve, have elements of evil in them. They are new and powerful forces, and they are factors for good or ill, as they are managed or controlled with wisdom or unwisdom."

The author has little faith in legislation, pointing out that, beginning with Robert Peel's act of 1802, "we have had 104 years of distinctive labor legislation in the mother country and in this . . . and yet I think no one would hesitate to say that the labor question is as intense to-day as at any time during the whole 104 years." Nevertheless regarding the outcome he is optimistic. Of socialism he thinks "the time has gone by when we should have any fear of the word. It has no very powerful menace in it; the kind we know in this country is harmless. It expends itself in the propagation of ideas relative to municipal and State ownership of some of the utilities which are necessary for our comfort and welfare." He bases his chief hope on collective bargaining, the trade agreement and arbitration—the first two to prevent strikes and the last to settle them. He gives many instances of the successful working of these institutions, and finally, as an appropriate conclusion of this review, he says, "I believe that the great era of strikes which has existed in this country since 1880 is passing away. . . . I make no limitation of time, but I do believe that the good sense of the working men of this country, co-operating with the good sense and the wisdom of the employers of labor, will see to it that strikes do not occur and that the public is not discommoded."

"Modern Engineering Practice." Edited by Frank W. Gunsaulus, assisted by a corps of engineers and experts. Twelve volumns with four thousand illustrations. The American School of Correspondence, Chicago. Price $60.

This is a very ambitious reference library made up largely of the instruction papers of the American School of Correspondence. It makes a general survey of mechanical and electrical engineering as will be seen from the following general summary of the subjects treated in the different volumes: Vols. I-V, Electricity; Vol. VI, Heat and Boilers; Vols. VII and VIII, Steam, Gas and Oil Engines; Vol. IX, Pattern Making and Founding; Vol. X, Machine Shop Work; Vol. XI, Drawing; Vol. XIII, Warming, Ventilation and Plumbing.

The books have been prepared by a corps of fifty-nine writers, among whom are several leading university professors. Contrary to what might be expected, however, the treatment is, so far as possible, non-mathematical and in no case is advanced mathematics used.

"Burns' Pipe Price Extender." By Eugene Burns. 27 3¼x6½-inch pages. David Williams Company, New York. Price 50 cents.

The object of this book of tables is to enable the list price of any quantity of merchant pipe to be obtained without multiplication. The value at list price for all sizes is tabulated by feet up to 100 feet with a separate table for the odd inches. By taking the quantities from the table, suitably shifting the decimal point and adding, the value of any quantity of pipe may be determined. The table will be found to be decidedly useful by all who have pipe pricing or estimating to do.

It seems that the so-called vacation trip of Thomas A. Edison to the South in an automobile, and which is attracting so much attention, is not altogether a pleasure excursion, as it is announced from Asheville that he has discovered in that section certain beds of cobalt which he states will enable him to much reduce the weight of storage batteries to be used in driving electric automobiles.

The Directory of the Engineers' Club of Philadelphia for 1906 (corrected to April 7th) contains lists of officers and members, charter and by-laws, house rules, etc. The membership on April 7, 1906, was 528, of whom 463 were active members.

New Tools and Machine Shop Appliances.

A COMPOSITE PULLEY.

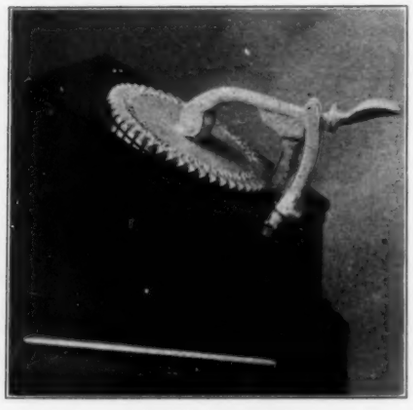
Wm. W. Whitcomb, president of the National Brake and Clutch Company, 16 State street, Boston, Mass., and inventor of the cork insert system for pulleys and clutches illustrated at page 567, has recently patented a composite pulley con-

A COMPOSITE PULLEY.

sisting as shown in the half-tone of a light-weight metal wheel with a wood rim of sufficient thickness to permit pockets to be formed for the reception of the cork inserts. It will be noticed that the pulley face is flat. This, it is stated, is preferable to a crowned surface, the cork inserts preventing the belt from running off.

AN EMBOSSING PRESS.

The illustration shows a hand-operated press for producing embossed name plates,



AN EMBOSSING PRESS.

tags, pattern letters, etc., on strip zinc, to be used on metal or wooden patterns, samples, tools, etc.

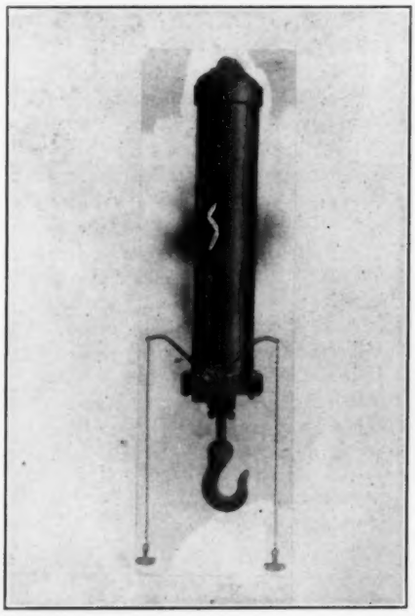
The letters and figures are gothic ¼ inch high and very legible, they are raised about 0.025 inch above the surface of the zinc.

The circular notched plate on top has a series of letters, figures, etc., on its face. The indexing of any of these locates a similar character over the strip of zinc in the machine, the lever is then depressed and strikes up the metal in the strip, the handle on being released rises and spaces the strip so that it is ready to receive the imprint of the next character. A starting and finishing shear, and a perforating punch are also provided.

This machine is built by Roovers Bros., 100 Schermerhorn street, Brooklyn, N. Y.

A BALANCED AIR HOIST.

These hoists are intended for foundries or where the control of the work must be sensitive and certain. With the balanced valve, air under pressure is always in the lower end of the cylinder. When the load is to be lifted, air is exhausted out of the upper end, causing the piston to move upward. To lower, air under pressure is entered at the upper end of the cylinder, which, together with the weight of and load on the piston, forces



A BALANCED AIR HOIST.

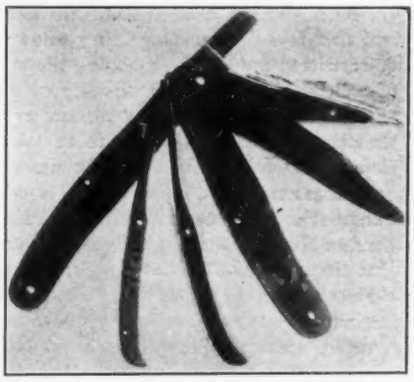
the air in the lower part of the cylinder back into the receiver. This method prevents jerking and pumping should the sling break. There is a safety valve which prevents dropping of the load should the hose break.

These hoists range in size from 4 to 19 inches diameter of cylinders, their capacities are from 800 to 20,000 lb. at 80 lb. pressure. The hoists are designed for 110 lb. pressure and at this pressure have a factor of safety of six. The cylinders are steel with the exception of the 4-inch size which is brass. All hoists are tested under load before shipping. They are made by Curtis and Company Manufacturing Company, St. Louis, Mo.

Three new balloons will be constructed in France for the United States army; They will have a silk web covered with aluminum foil.

A Steam Turbine which did its Duty under Difficulties.

The Allis-Chalmers Company 5500-kw. turbo-generator in the Brooklyn Rapid Transit power house seems to have had from the time of its installation, to make something of a fight against hard luck. It now appears that for nearly a month after starting, it was in the condition of a patient upon whom a laparotomy had been performed and in whose body the surgeon by accident sewed up one of his appliances, a form of oversight probably even more infrequent among surgeons than among machinists. In the case of the turbine the article was a knife, though not a surgeon's knife, but a large jack-knife, which when removed presented the appearance shown in the accompanying figure. The value of the shroud-ring of this turbine has been well demonstrated by the accident, for if the ends of the blades had been free and unprotected a large number of them would no doubt have been broken off. The initial starting of this turbine was described at page 676. The following is the account of the



JACK-KNIFE AFTER REMOVAL FROM STEAM TURBINE.

discovery of the presence of the knife within the casing.

Shortly after starting up the turbine one morning, after having been doing heavy work for several weeks, the hearing of a peculiar noise within the cylinder caused it to be stopped and opened up. Examination disclosed the fact that a piece of steel had become wedged between the spindle and the shroud of the first row of stationary blades and had acted like a lathe tool and cut into the body of the drum for a width of about three-eighths of an inch and for a depth of nearly three-sixteenths of an inch, the cut being alongside of and opening into the groove which holds the first row of spindle blades. This had resulted in loosening the calking strip which held the ring of blades in place (See page 178 for illustrations of the construction details). For a distance of five or six inches this strip had come partly out of its groove, thereby loosening the ring of blades, which therefore bent outward under the influence of centrifugal

force so that the channel-shaped shroud ring had rubbed hard in the bore of the cylinder, wearing the flanges of the ring down almost to the riveted-over tips of the blades. In spite of this severe condition none of the blades had become loosened or injured in any way.

Seeing that it would be unsafe to attempt to hold the blades in the damaged groove, and not wishing to keep the turbine out of service long enough to make permanent repairs, the engineer removed this one ring of blades, closed the cylinder and immediately put the turbine back into service.

An examination of the ring of blades which was removed showed that one-half was as good as when put in, while the other half was damaged only as to the wearing away of the flanges of the shroud-ring. With a new half shroud-ring this ring of blades would be in perfect condition.

An investigation as to the cause of the mishap showed that the piece of steel which had cut the groove in the shaft was apparently one of the leaves of a pocket-knife handle. Upon a further search the remainder of the metal parts of the knife were discovered; the outer covering of the handle, however, had disappeared. The large blade of the knife showed that it also had been rubbing hard.

At the time of the discovery the turbine had not been previously opened up for nearly a month, and the knife must therefore have gotten into the turbine at that time or before it, for it would have been impossible for it to get into the interior except when the turbine was opened up.

Increasing Use in the United States of Blast Furnace Gas Engines.

In view of the large amount of power which can be obtained from the waste gases from blast furnaces, and the demonstration in European practice of the satisfaction given by large gas engines using these gases as fuel, it is quite natural that the application of the gas engine to this service should now be going on in the United States. The Allis-Chalmers Company has recently received an order for its eighth gas engine for companies in the iron and steel industry, to be operated on blast furnace gas. Four of these units were horizontal blowing engines with air ends of Slick type, their aggregate capacity being 120,000 cubic feet of free air per minute; and the others are for direct connection to generators, with an aggregate output of 10,500 brake horsepower. The last one is for the National Tube Company, of Pittsburg, and is a 1500 brake horse-power horizontal twin tandem type gas engine for direct connection to a 1000 kilowatt direct current generator.

The Westinghouse Machine Company is also building gas engines for use in service of this description. In the rail mill of the United States Steel Corporation at Braddock, Penn., there are some large gas engines using blast furnace gas, driving electric generators, which furnish power to the rolling mills and other machinery; and the American Steel and Wire Company, a subsidiary concern of the United States Steel Corporation, is now equipping its plant at Worcester, Mass., with an 800-horse-power gas engine to operate the mill machinery.

Dirt with Wheat.

The India correspondent of the *Times* makes some horrifying statements by way of explanation of the bitter protests made by English millers on account of the admixture of dirt with wheat imported from India. This writer says:

In Canada, the United States, Argentina, and probably also in Egypt and Russia, the wheat is cleaned in thrashing machines. In India and throughout the East it is thrashed by being trodden out under the feet of oxen in the open fields. It stands to reason that by this method there must be a large admixture of dirt, of simple field earth, with the wheat. The recognized proportion of dirt allowed by English millers is 5 per cent. Hence it is the common practice of Bombay merchants engaged in the wheat trade to keep in their warehouses on the Port Trust, Bombay, two sets of machines. All their wheat as it arrives in the warehouse is sampled. That which contains more than 5 per cent. of dirt is first put through the cleaning machine to get rid of the dirt. This cleaned wheat is then put through the mixing machine, where it receives its exact 5 per cent. of dirt and is then ready for the wheat market in Europe.

The correspondent says that it is this miserable system which prevents elevators being erected in Bombay and the wheat as it arrives by train being delivered direct on board the steamers, although the larger flour mills in Bombay fully recognize the value of elevators, each having their own wheat elevator for their own consumption. But, he adds, the reform needed is for the millers in Europe gradually to reduce their allowance of dirt until it is abolished altogether. "As long as millers in Europe deduct 5 per cent. for dirt, so long will they get it. Eastern wheat shippers cannot be expected to lose 5 per cent. on each shipment, and therefore they add the deficiency of dirt in each sample as it arrives."

The Fourth Congress of the International Association for Testing Materials will be held at Brussels, Belgium, September 3-8, 1906.

Personal.

It is announced that the degree of Doctor of Engineering has been conferred upon George Westinghouse by the Technical University of Berlin.

F. H. Warren, the New England representative of the Lumen Bearing Company, has been appointed advertising manager also for the company.

W. C. MacKinnon, of New Bedford, Mass., has resigned his position there to become foreman of a department of the Union Twist Drill Works of Athol, Mass.

The degree of Doctor of Science was conferred on C. J. H. Woodbury, Assistant Engineer of the American Telephone and Telegraph Company, by Union College, June 12.

Geo. H. Baush, formerly superintendent of the Baush Machine Tool Company, of Springfield, Mass., will represent Hill, Clarke & Co. in Philadelphia, probably with an office on the "Bourse," where he will take care of the principal agencies.

N. A. Christensen, of Milwaukee., Wis., inventor of the Christensen air brake and compressor, the manufacture of which has just been taken over by the Allis-Chalmers Company, has entered the service of that concern as consulting engineer.

E. E. MacCarthy, who has been an occasional contributor to our columns, has become the president and treasurer of the newly organized General Manufacturing Company, of Elkhart, Indiana, which company has acquired the business of the new National Manufacturing Company, and will make bag-making and bag-printing machinery, besides doing general contract work in the building of machinery. Mr. MacCarthy learned his trade with the Wiley & Russell Manufacturing Company, of Greenfield, Mass., and afterward worked as a toolmaker at various places, including the Springfield Armory. He then went into the superintendent's office of the Westinghouse Electric and Manufacturing Company, at East Pittsburg, as a designer, and afterward took charge of the detail manufacturing department of that company. After this he became superintendent of the shops of Burroughs Adding Machine Company, at St. Louis, and assisted in the design and arrangement of their new plant at Detroit.

Obituary.

William L. Newsham, of Germantown, Penn., died recently at the age of 66 years. For many years he was superintendent and foreman of the I. P. Morris & Co., machine works, at Philadelphia. Later he became head of the sugar machinery manufactory of Newsham, Hock & Douglas. He also managed one of the most extensive machine plants in Canton, O. At the time of his death he was superintendent of a large manufacturing plant in Philadelphia.

Ashahel K. Eaton noted as an inventor and scientist, died recently in Brooklyn, N. Y., aged 84 years. Mr. Eaton was born in Stockbridge, Mass. He was graduated as a physician from Hamilton College in 1840, but devoted his life to

experimenting in chemistry and sciences. Among his inventions are a process for tanning, a method for manufacturing crucible steel, and a telephone, which was on the market twenty years ago.

Manufacturers.

The Waterbury (Conn.) Brass Company is erecting a new factory.

The Martinsburg (W. Va.) Power Company will erect a new plant.

The Lancaster (Pa.) Gas Light Company, is rebuilding its plant.

The John B. Schott Saddlery Company, Quincy, Ill., will erect a new factory.

The Fern Rock Mill Company, Philadelphia, Pa., will erect a $15,500 addition.

The Jefferson Chain Company, Carthage, N. Y., will erect a two-story addition.

The Wickersham Printing Company, Lancaster, Pa., is putting up a new plant.

The Monarch Fence Company, Adrian, Mich., has purchased site for a new plant.

The Reo Motor Car Company, Lansing, Mich., will erect two additions to its plant.

The Utica (N. Y.) Heating Company is erecting a new factory and office building.

The Troy (N. Y.) Malleable Iron Works has awarded contract for a new foundry.

The Cockburn Barrow & Machine Company, Jersey City, N. J., will erect a new factory.

The Chicago (Ill.) Screw Company has taken out a permit for a three-story factory.

Barry & Zecher, Lancaster, Penn., are erecting a new foundry for heavy castings.

The Cottrell Saddlery Company, Richmond, Va., is erecting a four-story addition.

The Stanley Rule and Level Company, New Britain, Conn., will make additions to its plant.

The plant of the Barberton (Ohio) Canning Company was destroyed by fire. Loss, $10,000.

The Davenport (Ia.) Bag and Paper Company, will enlarge its plant by a five-story addition.

The Capital Trunk & Manufacturing Company will erect a four-story factory in Pittsburg, Pa.

The Sioux City (Iowa) Foundry and Manufacturing Company will erect a new machine shop.

A $5000 addition will be built to the plant of the American Pulley Company, Philadelphia, Pa.

The Continental Car and Equipment Company, New York, will erect a plant in Highland Park, Ky.

The Wallingford (Vt.) Manufacturing Company, hardware specialties, will build a new forge room.

The Batavia (Ill.) Manufacturing Company, farm implements, is planning an addition to its plant.

The Alfred A. Guigues Leather Company, Newark, N. J., is having plans prepared for a new tanning house.

B. G. Cheney, president of the Montesano (Wash.) Business Men's League, and others, will build a shingle mill.

Rogers & Bro., manufacturers of silver-plated ware, Waterbury, Conn., will erect a new two-story factory.

Plans have been prepared for a new $20,000 tannery for the Eagle Tanning Company, Grand Haven, Mich.

The Leonard Stove Company, Bowling Green, Ohio, is rebuilding its plant which was recently destroyed by fire.

The American Ring Company, Waterbury, Conn., manufacturer of stamped brass goods, is erecting an addition.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Patented machines built to order. Interstate Machinery Co., Troy, N. Y.

Brass foundry desires work on yellow brass castings. Brooklyn, Care AMER. MACHINIST.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Good tool or machine specialty wanted. Give full particulars. Automatic, 660, AM. M.

Working drawings. Experimental work. George M Mayer, 1131 Monadnock Bldg., Chicago, Ill.

Light and fine machinery to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Gas engines designed to order. Marine and automobile work a specialty. H. L. Towle, 150 Nassau street, New York.

Wanted—A No. 1 universal milling machine, new, or one in first-class condition. Box 727, AMERICAN MACHINIST.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—A copy of AMERICAN MACHINIST of date July 18, 1889. Will pay $2.00 for same. Address McN—, care AMER MACH.

Wanted—To complete volume, AMERICAN MACHINIST of April 13, 1905. Will pay premium. Box 613, AMERICAN MACHINIST.

Punch press wanted. Bed opening about 22 in. Also No. 1 Universal miller. E. B. Abbott, 2912 Central avenue, S. E., Cleveland, Ohio.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear and Machine Co., 141 Oxford street, Philadelphia, Pa.

A good, cheap shafting lathe 28 in. or 30 in. by 30 ft. No objection to good second-hand one, must be fully guaranteed. Box 720, AMERICAN MACHINIST.

Wanted—Work evenings, at mehanical and structural design, development, shop details, etc., by experienced technical and practical man. J. H. Brown, 1524 Madison avenue, New York.

Wanted—Worms, spirals and screws to cut. We are equipped with special machines for milling these parts. Get our prices on doing some of your difficult jobs. Parsons & Lane, Sodus, N. Y.

Mechanical Draftsman—All-around man on machinery, furnaces, and plant construction. For general work with a large copper refining company in Illinois. Engineering Agency, Monadnock Block, Chicago.

Specialties—We make on contract, specialties for marine, automobile and general use, and do general machine-shop work on small brass goods. Lovell-McConnell Mfg. Co., Currier Bdg., opp. Pennsylvania Railroad Station, Newark, N. J.

A manufacturing concern having one of the most modern and complete plants in Ohio for the manufacture of brass and iron specialties, including steam goods, solicits orders for special work in quantity lots. Address N. L. H., 172 West Locust street, Columbus, Ohio.

We build special machinery, tools, etc., for responsible parties at prices which will demonstrate our modern practice and facilities. Estimates gratis. Send drawing for our lowest bid. New Haven Tool and Machine Specialty Co., 456 Broad st., Bridgeport, Conn.

Tool catalog No. 22, 950 pages bound in cloth. Greatest small-tool catalog ever published. Will be sent post-paid on receipt of $1. Money paid for catalog refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton street, New York City.

For Sale.

For Sale—Excellent machine-shop building, with power, in Philadelphia; 60x90 feet, three stories, solid ground floor. Box 545, AM. M.

For Sale—One 16"x10' engine lathe and one 12"x5' engine lathe, both practically good as new. L. T. Gauss, 222 Mill street, Rochester, N. Y.

For Sale—Second-hand Taylor water-tube boiler, used only two months; 2000 sq. ft. heating surface, 56 sq. ft. grate surface; sections easily transported. Box 701, AM. MACH.

For Sale—Machinery-manufacturing plant, including machinery, tools, jigs and good will. Doing a business of from $100,000 to $150,000 per year; can secure buildings with water power at very reasonable rent for term of years. Address J., Box 678, AMER. MACH.

For sale or rent for a number of years, well equipped brick foundry 60x60; 5-ton Whiting Cupola; machine shop 50'x200'; all machinery and tools practically new; including Bullard 72" boring mill; Bickford radial drill; Gray planer, and seven Bradford and other lathes, etc. Own side track, electric light plant, and water in good town with seven R. R. in N. W. Ohio. Address J. O. Ohler, Atty. Care AMERICAN MACHINIST.

For Sale—Complete electroplating outfit, including one 500-ampere dynamo, one 5 and one 10-horse-power motor 500-volt direct-current, two cedar and three iron-tanks, together with nickel, brass, bronze and copper anodes, rheostats, switches, grinding and polishing lathes, carborundum, bull neck, canvas, felt and cotton wheels, power press, wood pulleys, shafting, hangers, belting and supplies. Jim Bowstead, Room 6, New Kiley Block, Marion, Indiana.

Business Opportunities.

Wanted—Thorough business party to take an interest in, or buy a going foundry, and small machine shop, now receiving orders for five tons castings daily. Address L., 1918 Morris avenue, Birmingham, Ala.

Superintendent of small concern would like to correspond with parties in need of a good executive and up-to-date mechanic. Have some gilt-edge propositions. A-1 references, can invest. Have built iron and wood working machinery. Box 730, AM. M.

Wants.

Situation and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Engineer (English) seeks responsible position; 11 years' experience in H. M. Royal Navy; have had charge of erecting steam, electric and air-compressing machinery. Box 698, AMERICAN MACHINIST.

MASSACHUSETTS.

Position as foundry foreman; change for promotion, Baltimore or Philadelphia; no agents. Box 694, AMERICAN MACHINIST.

Experienced designer of special and automatic machinery and tools desires position. Practical experience, a hustler and can make others hustle also. Box 729, AMER. MACH.

Skilled designer wants work; 12 years' experience in the shop building experimental machinery, 10 years designing. Hand operations made automatic. Have had experience in wood, metal, and textile machinery. Box 721, AMERICAN MACHINIST.

NEW JERSEY.

Mechanical draftsman; technical graduate; 20 years' practical experience in mining machinery, steam and gas engine plant, seeks position with mining and engineering company. Box 715, AMERICAN MACHINIST.

Engineer desires change; where now employed has charge of drafting room, shops, power plant, construction and maintenance and purchasing department; thorough practical training in all branches. Box 689, AM. M.

Young progressive engineer, executive of factory employing two hundred skilled mechanics, wishes to make a change about Sept. 1. Thoroughly versed in cost keeping and

manufacturing systems. Position as assistant chief engineer or superintendent desired in large plant, working on staple products. Present income $4500; remuneration to be arranged. Box 723, Care AMER. MACH.

NEW YORK.

Responsible position in steam turbine manufacture; several years' experience. Box 631, AMERICAN MACHINIST.

Young technical graduate, four years' experience gas and oil engines, wishes to change position. Box 718, AMER. MACH.

General foreman, successful in producing first-class work at satisfactory cost, varied experience in high-grade machinery; master machinist, desires change. Box 675, AM. M.

Position wanted by mechanical engineer; expert on internal combustion engines; thoroughly practical and familiar with modern shop methods. Box 726, AMER. MACHINIST.

Mechanical engineer; fourteen years' practical experience special machinery and tool designing; at present employed by a large concern, desires a change. Address Box 713, AMERICAN MACHINIST.

Young man, good technical education, at present employed as mechanical draftsman, desires employment with manufacturing or engineering concern in some other capacity. Box 722, AMERICAN MACHINIST.

Wanted—Position in publicity department of manufacturing establishment in Eastern territory; experienced in the preparation of copy and with the details of cut making and printing. Box 681 AMERICAN MACHINIST.

Mechanical engineer; German technical graduate, six years' experience on conveying and hoisting machinery, wire rope tramway, etc., would accept a position in any of the above or similar lines. Box 714, AM. MACH.

Pattern maker wants steady position. Been with J. L. Mott Foundry Company six years, left account moving plant to Trenton, N. J. Best references from principal machine shops in light and heavy work. McCulloch, 559, E. 140th street, New York.

Wanted—Superintendency or assistant, young hustling mechanic, familiar with modern methods, technically educated, practical experience, good executive, has responsible position, desires change, references. Box 728, AMERICAN MACHINIST.

Works manager or superintendent; mahinist; technical graduate; general manufacturing experience. Successful methods in production and costs. Executive ability and energy. Good organizer; understand how to get results; age 31, married. Present position superintendent of works. Box 717, AMERICAN MACHINIST.

Superintendency or general foremanship by a hustling young mechanic; good handler of men and work; clever designer of jigs and special appliances; successful department organizer and systemizer; specially experienced in heavy machinery manufacturing; good cause for desired change; will give past and present employers as references. Box 724, AMERICAN MACHINIST.

Competent superintendent would like to change; experienced toolmaker tool designer, master mechanic and superintendent; 16 years' experience in the commercial manufacturing of small and medium interchangeable machinery; position preferred with some typewriter, adding machine or automobile manufacturing company; a cost reducer. Box 650, AMERICAN MACHINIST.

PENNSYLVANIA.

Mechanical engineer and superintendent, 15 years' experience in general line, such as machine tools, cranes, hydraulic machinery, etc., wants to change. Can design and produce good work cheaply. Box 656, AM. MACH.

FOREIGN.

Superintendent, experienced man of energy, judgment and executive ability, returning to the States after successful installation of large engineering works in England, is open for engagement. Sept. 1, 1906. Box 710, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—Draftsmen wanted at once. Openings for a number of good draftsmen, but especially those familiar with (1) general mechanical work, or, (2) switchboard layout, or, (3) induction motor design, or, (4) large alternator design; in one of the largest shops in Canada. Address Box 712, AMER. MACH.

CONNECTICUT.

Wanted—Several competent all-around jobbing machinists. The Eastern Machinery Co., New Haven, Conn.

Wanted—A-1 machinist for constructing delicate apparatus, also, young energetic machinist foreman. Good opportunity for the right men. Box 711, AMERICAN MACH.

Wanted—High-grade floor and machine hands. Steady work and good wages to first-class men familiar with heavy work. None other need apply. Address, stating experience and wages required. Farrel Foundry & Machine Co., Ansonia, Conn.

ILLINOIS.

Wanted, draftsmen—We want capable draftsmen of either electrical, mechanical or general experience. If you would like to change your position or its location, write and tell us about the character and extent of your work. Address, giving full particulars, to Western Eectric Company, Dept. N. 29, Chicago.

MASSACHUSETTS.

Wanted—A few good, clean young men of mechanical turn of mind to work on fine tools. Several wanted in our micrometer department; those with experience preferred; steady employment guaranteed to the right men at good pay, according to experience and ability. Address, with references, The L. S. Starrett Co., Athol, Mass.

MINNESOTA.

Wanted—First-class machinist, moulders and patternmakers, also structural template makers and structural iron workers. We are daily increasing our business and will consider applications from competent mechanics in the above branches of our business. Address, with references, Minneapolis Steel and Machinery Co., Minneapolis, Minn.

NEW JERSEY.

Wanted—Mechanical electrical draftsmen; only first-class men need apply. Box 508, AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work to good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

Wanted—At once a competent designer on jigs and fixtures and special machinery to take charge of drawing room. Apply with copies of references and state experience, age and nationality and salary expected. P. O. Box 214, Newark, N. J.

Wanted—High-class man for superintendent of plant employing 100 men manufacturing metal specialties for automobile trade; must have executive ability of the highest order and be capable of organizing works to best advantage. Box 688, AMERICAN MACHINIST.

Foreman to take entire charge of shop manufacturing speed-meters in large lots. To a man who is now employed in similar work, and making a success, we can offer a permanent position at a good salary. State present position and pay expected. All communications treated confidentially. Motor Car Specialty Co., Trenton, N. J.

Wanted—Foreman accustomed to the production of light interchangeable work, with good general knowledge of toolmaking. Must have through understanding of modern methods of manufacture and be possessed of good executive ability, accustomed to handling help. Good opportunity for right man. Give experience in detail, age, references and salary expected. Box 706, AMERICAN MACHINIST.

NEW YORK.

Draftsmen wanted for jig and fixture work, apply Mergenthaler Linotype Company, 20-42 Ryerson street, Brooklyn.

Wanted — Experienced draftsmen, toolmakers and machinists. Give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

Wanted—Experienced dratfsmen on die, jig and fixture work, also one familiar with pattern work for machine molding. Address Box 719, AMERICAN MACHINIST.

Wanted—Assistant pattern shop foreman experienced on small engine or pump patterns, will qualify for our work. Location Greater New York. State references, experience and pay expected. Box 725, AM. MACH.

Wanted—Tool maker for responsible position in New York City. Excellent opportunity for a young married man. Only letters containing full particulars, expectations and references considered. Address Box 716, AM. M.

Ingersoll-Rand Co., Painted Post, N. Y., is rapidly increasing force and invites applications from machinists for all branches of the trade. Excellent opportunity is offered energetic, capable young men. Box 641, AM. M.

Wanted—A foreman to take charge of die room containing 25 to 30 diemakers, making punching, banking and drawing dies for light sheet steel and brass work. Reply, stating age, experience and wages expected, to Box 699 AMERICAN MACHINIST.

Draftsmen Wanted—First-class electrical-mechanical draftsmen; only practical experienced men need apply. State age, experience, reference and salary expected. Permanent position if satisfactory. Address Box 707, AMERICAN MACHINIST.

Wanted—Foreman for knife and bar department of factory in New York state. Must be wide awake and thoroughly experienced in latest and best methods of making knives, cutter bars, etc. State age, experience and salary expected. References required. Box 708, AMERICAN MACHINIST.

Wanted—For a large manufacturing establishment, a general foreman to take charge of tool room containing 170 toolmakers, with five assistant foremen; engaged in making jigs and fixtures, ornamental and drop-forge die work, and a general line of small cutters, reamers, taps, etc.; also miscellaneous machine repairs. An excellent opportunity for the right man. Reply, stating age, experience and wages expected, to Box 700, AM. MACH.

OHIO.

Wanted—High-grade machinist for engine work. S. M. Jones Company, Toledo, Ohio.

Three or four competent mechanical draftsmen. In replying, give full information, including rate expected. Box 686, AM. MACH.

Wanted—One good die sinker, and also one man that understands drop forging. Address, Humane Horse Shoe Co., Lima, Ohio.

Good draftsman with experience in designing, by a machine tool concern in Cincinnati. One familiar with radial drills and screw and turret machinery preferred. Excellent future. State age, salary, experience and address Box 23, Sta. B., Cincinnati, O.

The National Metal Trades Association can place a few first-class wood patternmakers, toolmakers and all-around machinists. Highest wages and steady employment guaranteed. Address, with references, Robert Wuest, Secretary, 1416 Union Trust Bdg., Cincinnati, O.

PENNSYLVANIA.

Wanted—First-class draftsman on mill construction and equipment, technical man preferred. Box 578, AMERICAN MACHINIST.

Wanted—Thoroughly experienced erecting machinists, accustomed to steam engine or compressor work. The Blaisdell Machinery Co., Bradford, Pa.

Wanted—First-class instrument and toolmakers; also large machine-tool operators. Address Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

Wanted—A first-class man as general foreman of our brass department on brass globe, angle and gate valves, and a general line of steam goods. Factory located in western Pennsylvania. To the right party we have a good position to offer. State age and experience. Address Box 692, AMER. MACHINIST.

Wanted—Chief engineer to take charge of steam plant located in central Pennsylvania, consisting of 2500-h.p. Heine boilers, one 1200-h.p. Allis Corliss compound engine and three simple engines 150 h.p. each. Must have enough executive ability to handle plant and men in good shape. State age, if married, previous experience and salary desired. Box 709, AMERICAN MACHINIST.

The Monotype Company maintains a free school for training young machinists to operate its type casting and composing machines. The demand for monotype operators is so great that it receives more applications for places in its school than can be filled. In making selections these qualifications carry most weight: Character, common sense, experience with automatic machinery (or) printing-office experience, or type-foundry experience. Full particulars will be furnished to inquirers who furnish full particulars about themselves. Lanston Monotype Machine Co., 1231 Callowhill St., Philadelphia, Pa.

RHODE ISLAND.

Toolmakers wanted—First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Pierce Mfg. Co., Woonsocket, R. I.

WISCONSIN.

As the result of doubling its new West Allis plant, Allis-Chalmers Co., of Milwaukee, needs more patternmakers, machinists and moulders.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Wanted—Competent, resourceful mechanics to learn adding-machine repair work. Steady employment in our branch houses after proper course of instruction at factory. Give experience. Box 634, AMERICAN MACHINIST.

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Cling-Surface Co., Buffalo, N. Y.
Dixon Crucible Co., Jos., Jersey City, N. J.
Shultz Belting Co., St. Louis, Mo.

Belt Filler

Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.

Belting, Leather

Main Belting Co., Phila., Pa.
Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Bending Machinery, Plate

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

Bending Machines, Hydraulic

Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bethehem Foundry & Mach. Co., So. Bethlehem, Pa.

Bending Machines, Power —*Continued.*

Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Sellers & Co., Wm., Phila., Pa.

Bending Tools, Hand

Estep & Dolan, Sandwich, Ill.
Wallace Supply Co., Chicago, Ill.

Bicycle Parts

Standard Welding Co., Cleveland, Ohio.

Blanks, Nut and Screw

Whitman & Barnes Mfg. Co., Chicago, Ill.

Blocks, Chains

See Hoists, Hand.

Blowers

Am. Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Garden City Fan Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Roth Bros. Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines

Buckeye Engine Co., Salem, O.
General Electric Co., New York.

Boilers

Struthers-Wells Co., Warren, Pa.

Bolt and Nut Machinery

Acme Machry. Co., Cleveland, O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Brown Co., H. B., Easthampton, Conn.
Detrick & Harvey Mach. Co., Baltimore, Md.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Landis Machine Co., Waynesboro, Pa.
Northern Elec. Mfg. Co., Madison, Wis.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Machinery Co., Bowling Green, Ohio.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolts, Coupling

Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Bolts and Nuts

Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Books, Mechanical

American School of Correspondence, Chicago, Ill.
Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York
Sames, C. M., Jersey City, N. J.
Wiley & Sons, Jno., New York.

Boosters

Burke Electric Co., Erie, Pa.
C & C Elec. Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.

Boosters—*Continued.*

Stanley-G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleveland, Ohio.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills

American Tool Wks., Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boxes, Tote

Cleveland Wire Spring Co., Cleveland, O.

Boring Tools

Armstrong Bros. Tool Co., Chicago, Ill.

Brackets, Lamp

Standard Welding Co., Cleveland, Ohio.

Brazing Plates

Phillips-Laffitte Co., Phila., Pa.

Broker, Machinery

Warner, C. S., Niagara Falls, Ont.

Bulldozers

Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Prentiss Tool & Supply Co., New York.

Burners, Oil

Tate, Jones & Co., Pittsburg, Pa.

Cabinets, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.

Calipers

Athol Machine Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams

Boston Gear Works, Boston, Mass.

Carborundum

See Grinding Wheels.

Castings, Brass and Bronze

Lumen Bearing Co., Buffalo, N. Y.

Castings, Die Molded

Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.
U. S. Foundry & Sales Co., South Norwalk, Conn.

Castings, Motor

Brush & Hudson, Brooklyn, N. Y.

Castings, Steel

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel

Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines

Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mahine Co., D. E., New London, Conn.

Centers, Planer

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worester, Mass.

Chains, Driving

Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link-Belt Engr. Co., Phila., Pa.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold

Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines

American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.

Chucks, Drill—*Continued*
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Westcott Chuck Co., Oneida, N. Y.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co.,, Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.

Chucks, Split
Hardinge Bros., Chicago, Ill.
Rivett Lathe Mfg. Co., Boston, Mass.
Westcott Chuck Co., Oneida, N. Y.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.
Switchboard Equipment Co., Bethlehem, Pa.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps
Billings & Spencer Co., Hartford, Conn.

Clutches, Friction
American Tool and Machine Co., Boston, Mass.
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V. Phila., Pa.
Double Friction Coil Clutch Co., Chicago, Ill.
Eastern Machy. Co., New Haven, Conn.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., N. Y.
Reeves Pulley Co., Columbus, Ind.
Wood's Sons Co., T. B., Chambersburg, Pa.

Coal Handling Machinery
Link-Belt Engineering Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleve., O.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Curtis & Co., Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Mietz, August, New York.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas
Ingersoll-Rand Co., New York.

Condensers
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.

Conduit, Interior
Sprague Elec. Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.

Controllers and Starters, Electric Motor
Case Mfg. Co., Columbus, Ohio.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Coping Machines
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Cork Inserts
National Brake & Clutch Co., Boston, Mass.

Correspondence Schools
See Schools, Correspondence.

Cost Systems
Wright, Harold A., New York.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Morse Twist Drill & Mach Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.

Counters, Machinery
Durbrow & Hearne Mfg. Co., New York.
Veeder Mfg. Co., Hartford, Conn.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplers, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, Ohio.
Cresson Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Sellers & Co., Wm., Phila., Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Woods Sons Co., T. B., Chambersburg, Pa.

Cranes
Alliance Machine Co., Alliance, Ohio.
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, Ohio.
Chisholm & Moore Mfg. Co., Cleveland, O.

Cranes—*Continued*
Cleveland Crane & Car Co., Wickliffe, Ohio.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co., Mfg. Co., St. Louis, Mo.
Frevert Machinery Co., New York.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg Co., New York.

Cranes, Portable
Nicholls, Wm. S., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers
Ingersoll-Rand Co., New York.
Link-Belt Engineering Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Elliott Chemical Works, Newton, Mass.

Cut Meters
Niagara Tachometer & Inst. Co., Niagara Falls, N. Y.
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Ingersoll Milling Mach. Co., Rockford, Ill.
International High Speed Steel Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Mach. Co., Pittsburg, Pa.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Machine Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Dies, Drop Forging
National Tool & Stamping Co., Philadelphia, Pa.

Diamond Tools
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos. L., New York.

Dies, Sheet Metal
Amerian Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Kent & Co., Edwin R., Chicago, Ill.

Dies, Sub-Press
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Drawing Boards and Tables
Obermayer Co., S., Cincinnati, O.
Queen & Co., Philadelphia, Pa.

Drawing Materials
Soltmann, E. G., New York.
Queen & Co., Philadelphia, Pa.

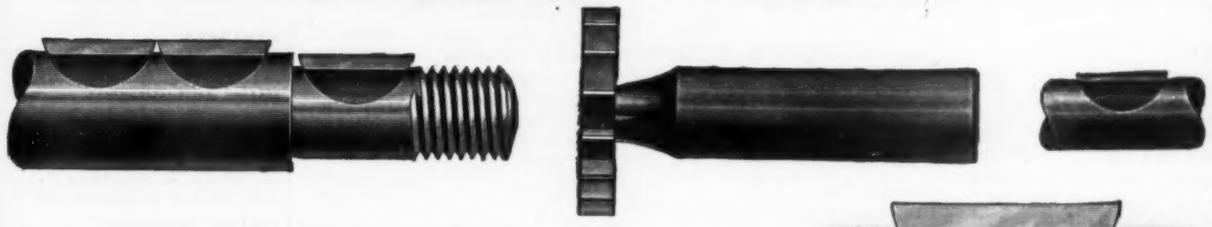
Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

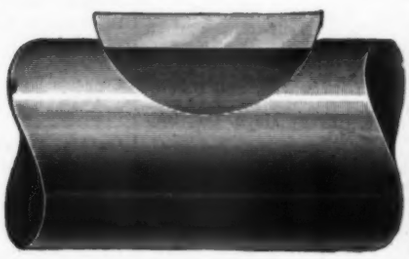
Drift Bolt Drivers
Ingersoll-Rand Co., New York.

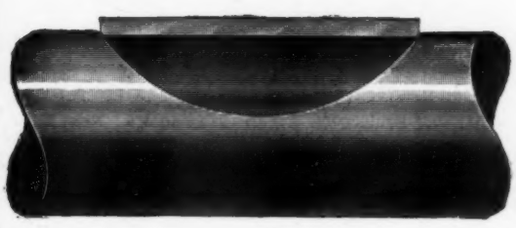
Drilling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Dwight Slate Machine Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Dwight Slate Machine Co., Hartford, Conn.
Fenn-Sadler Mach. Co., Hartford, Conn
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg Co., Hartford, Conn.







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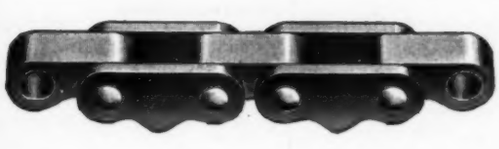
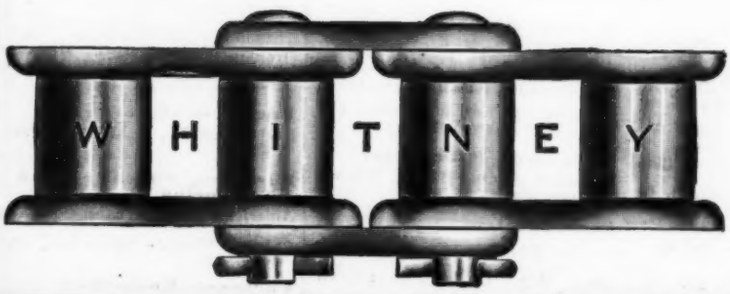




THE

WHITNEY MFG. CO.,

Hartford, Conn., U.S.A.

Drilling Machines, Multiple Spindle—*Continued.*

Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Three Rivers Tool Co., Three Rivers, Mich.

Drilling Machines, Portable

Cincinnati Elec Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York

Drilling Machines, Radial

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mach Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Drilling Machines, Turret

Niles-Bement-Pond Co., New York

Drilling Machines, Upright

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinati, O.
Davis Machine Co., W. P., Rochester, N. Y.
Dwight Slate Machine Co., Hartford, Conn
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center

Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand

Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co, New York.

Drills, Pneumatic

Chisholm & Moore Mfg. Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York

Drills, Rail

Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co. New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock

Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drying Apparatus

Sturtevant Co., B. F., Hyde Park, Mass.

Dust Collectors

Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N.J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley-G. I. Elec. Mfg Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Dynamotors

Sprague Elec. Co., New York.

Electrical Supplies

Clark, Jas., Jr., & Co., Louisville, Ky.
D'Olier & Co., H., Phila., Pa.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley-G. I. Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery

American Tool Wks. Co., Cin., O.
Clark, Jas., Jr., & Co., Louisville, Ky.

Electrically Driven Tools and Machinery—*Continued.*

Cincinnati Electrical Tool Co., Cincinnati, O.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Roth Bros. Co., Chicago, Ill.

Elevators

Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.

Emery Wheels

See Grinding Wheels

Emery Wheel Dressers

Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Dickinson, Thos. L., New York.
Heald Machine Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.

Enclosures, Tool-room

Hart & Cooley, New Britain, Ct.
Merritt & Co., Philadelphia, Pa.

Engineers, Consulting, and Mechanical

Dodge & Day, Philadelphia, Pa.

Engineers, Electrical

Crocker-Wheeler Co., Ampere, N. J.
Dodge & Day, Philadelphia, Pa.

Engines, Automobile

Franklin Mfg. Co., Syracuse, N. Y.
Olds Gas Power Co., Lansing, Mich.
Reeves Pulley Co., Columbus, O.

Engines, Gas and Gasolene

Automatic Mach. Co., Bridgeport, Conn.
Blaisdell Machinery Co., Bradford, Pa.
Bowers, E. J., Philadelphia, Pa.
Foos Gas Engine Co., Springfield, Ohio.
Greendale Gas Engine Co., Worcester, Mass
Jacobson Mach. Mfg. Co., Warren, Pa.
Mathews, Hugh, Kansas City, Mo.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, O.
Olds Gas Power Co., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Gas

Backus Water Motor Co., Newark, N. J.

Engines, Oil

Mietz, August, New York.

Engines, Steam

Buffalo Forge Co., Buffalo, N. Y.
Buckeye Engine Co., Salem, Ohio.
Garden City Fan Co., Chicago, Ill.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery

Gorton Mach. Co., Geo., Racine, Wis.
Roovers Bros., New York.

Exhaust Heads

Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition Machinery

Philadelphia Bourse, Phila., Pa.
Abel, C. C., New York.

Expanders, Boiler Tube

Nicholson & Co., W. H., Wilkesbarre, Pa.

Fans, Electric

Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., Elizabethport, N. J.
General Electric Co., New York.

Fans, Electric—*Continued*

Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley-G I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust

Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Feathers

Standard Gauge Steel Co., Beaver Falls, Pa.

Files and Rasps

Barnett Co. G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

Filing Machines

Cochrane-Bly Co., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Elmira Machine Works, Elmira, New York.
Grant Mfg. & Machine Co., Bridgeport, Conn.
Henry & Wright Mfg. Co., Hartford, Conn.

Flexible Shafts

Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co. Pittsburg, Pa.

Forges

Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Rand Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop

Billings & Spencer Co., Hartford, Conn.
Crescent Forging Co., Oakmont, Pa.
Monarch Wrench Works, St. Louis, Mo.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic

Wyman & Gordon, Worcester, Mass.

Forgings, Steel

Baldwin Steel Co., New York.
Boker & Co., Hermann, N. Y.
Crescent Forgings Co., Oakmont, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon Co., Worcester, Mass.

Foundry Furnishings

Adams Co., Dubuque, Iowa.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers

Sturtevant Co., B. F., Hyde Park, Mass.

Furnaces, Annealing and Tempering

American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Furnaces, Enameling

American Gas Furnace Co., N. Y.

Brown & Sharpe Manufacturing Co.

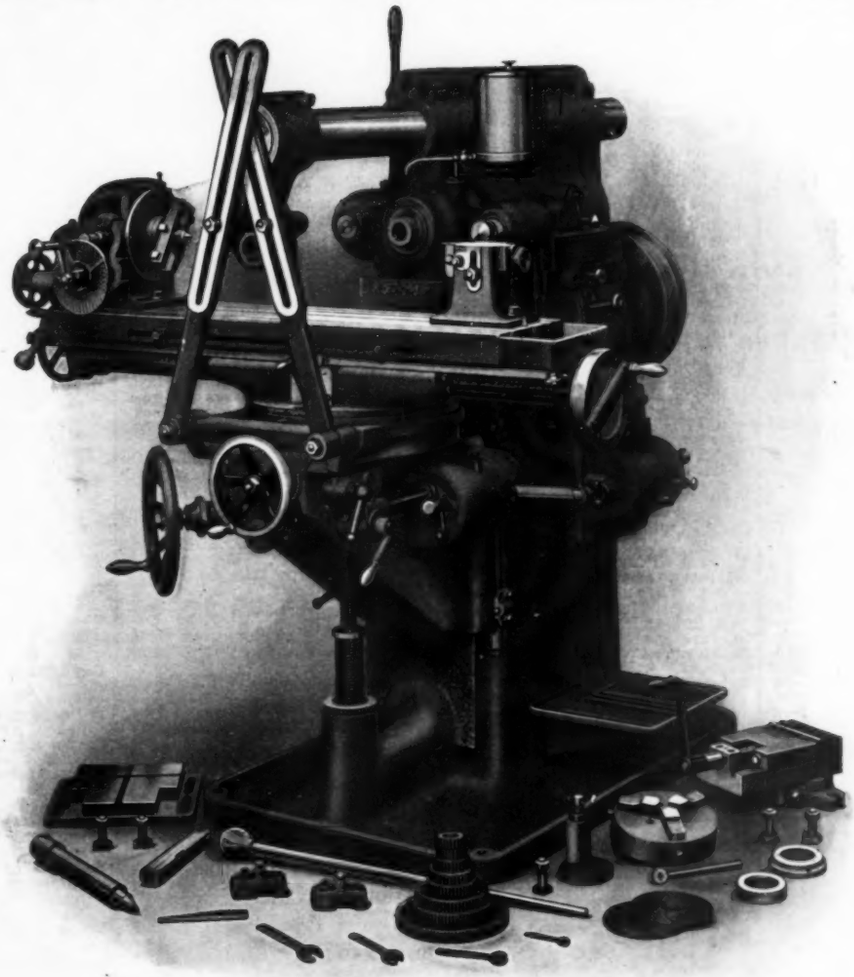
PROVIDENCE, R. I., U.S.A.

DRIVING POWER

the Salient Feature of a

B. & S.

Constant Speed Drive Milling Machine.



HOW THE POWER IS OBTAINED.

A driving pulley of LARGE DIAMETER, taking a WIDE BELT and moving at a HIGH CONSTANT SPEED over a counter-shaft pulley of EQUAL DIAMETER, gives

High Belt Velocity and Large Belt Contact.

If a motor drive is desired, it can be obtained without the slightest alteration in the machine and the same high efficiency be available at all times.

DESCRIPTIVE PAMPHLET MAILED UPON APPLICATION.

Furnaces, Gas

American Gas Furnace Co., N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Obermayer Co., S., Cincinnati, O.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting

American Gas Furnace Co., N. Y.

Furniture, Machine Shop

Hart & Cooley Co., New Britain, Conn.
Manufacturing Equip. & Engineering Co., E. Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co. New Britain, Conn.

Gas Blowers and Exhausters

Sturtevant Co., B. F., Boston, Mass.

Gages, Recording

Bristol Co., Waterbury, Conn.

Gages, Standard

Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Mass. Tool Co., Greenfield, Mass.
Morse Twist Drill & Mach. Co., New Bedfrd, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam

Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery

Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bilgram, Hugo, Philadelphia, Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Machine Co., Hartford, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear and Mach. Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Morse-Williams & Co., Phila., Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co, New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sloan & Chace Mfg. Co., Newark, N. J.
Walcott & Son, Geo. D., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery

Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach Co., New Bedford, Mass.

Gears, Cut

Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mach. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear and Mach. Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
James, D. O., Chicago, Ill.

Gears, Cut—*Continued*

Morse-Williams & Co., Phila., Pa.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Molded

Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cin., O.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Rawhide

Boston Gear Works, Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mach Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., The, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.

Gears, Worm

Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse-Williams & Co., Phila., Pa.
James, D. O., Chicago, Ill.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Generating Sets

Burke Electric Co., Erie, Pa.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.
Van Dorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Generators, Gas

American Gas Furnace Co., New York.

Gibs

Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite

Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Automatic Knife

Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center

Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg Co., Worcester, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mach. Tool Co., Cin,. O.
Niles-Bement-Pond Co., New York

Grinders, Cock

Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter

Bath Grinder Co., Fitchburg, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.

Grinders, Cutter—*Continued*

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, Ohio.
Crocker-Wheeler Co., Ampere, N.J.
Dayton Machine & Tool Works, Dayton, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett-Dock Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Cylindrical

Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk

Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov, R. I.
Gardner Machine Co., Beloit, Wis.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.

Grinders, Drill

Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal

Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinders, Piston Ring

Heald Mach. Co., Worcester, Mass.

Grinders, Portable

Cincinnati Electrical Tool Co., Cincinnati, O.
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Machine Co., Cincinnati, O.
Landis Tool Co, Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Grinders, Tool—*Continued*

Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, Ohio.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hratford, Ct.

Grinding and Polishing Machines

Abrasive Material Co., Philadelphia, Pa.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Independent Pneumatic Tool Co., Chicago, Ill.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Webster & Perks Tool Co., Springfield, O.
Wells, Sons Co., F. E., Greenfield, Mass.

Grinding Wheels

Adams Co., Dubuque, Iowa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames

Athol Machine Co., Athol, Mass.
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery

Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

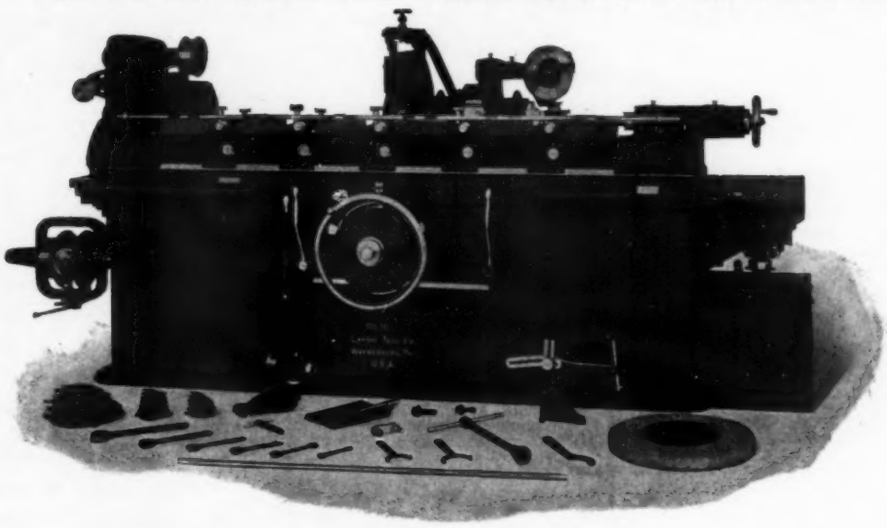
Hammers, Drop

Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.

LANDIS COMMENT ON GRINDERS.

To keep well to the front you should be familiar with grinders and the resultful ways of using them.

Landis Machines produce a larger output in a given space of time than is possible to turn out on the lathe and the work is of higher quality, more highly finished, more true and accurate.



Grinding Machines have reached their highest developments in the New Landis. You will find in our line the machine which most fully meets your requirements.

Don't deny yourself information that would lead to larger profits.

Let us send you details.

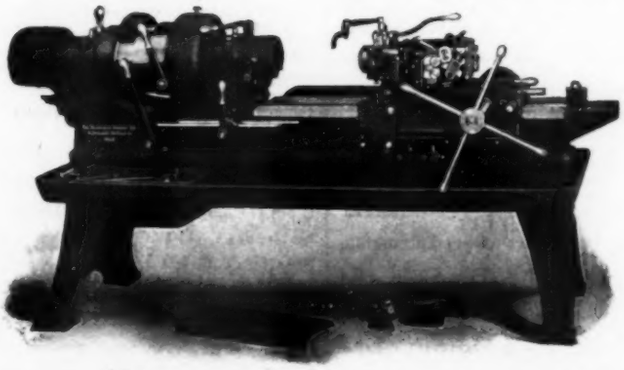
Landis Tool Company, Waynesboro, Pa., U. S. A.

AGENTS—W. E. Flanders, 309 Schofield Building, Cleveland, Ohio, and 933 Monadnock Blk., Chicago, Ill. Walter H. Foster Co., 114 Liberty St., New York. C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg. Alfred H. Schutte Cologne, Brussels, Liege, Paris, Milan and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Canada.

Warner & Swasey Turret Lathes always

Represent all that makes for **QUALITY** in machine tools—*Hollow Hexagon Turret Lathes* represent the highest development in this class of machine tools.

The detailed particulars are interesting—should interest you
Will be sent upon request—or representative will call.



The Warner & Swasey Co.,

Cleveland, Ohio, U. S. A.

Turret Lathes—Screw Machines—Brass Working Tools

FOREIGN AGENTS—Chas. Churchill & Co., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. Schuchardt & Schutte, Berlin, Vienna, St. Petersburg and Glasgow. Alfred H. Schutte, Cologne, Paris, Brussels and Milan. H. W. Petrie, Toronto. Williams and Wilson, Montreal.

Hammers, Drop—*Continued*
Prentiss Tool & Supply Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dayton Pneumatic Tool Co., Dayton, O.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Sellers & Co., Wm., Phila., Pa.

Hammers, Power
Bradley & Son, C. C., Syracuse, N. Y.
Fairbanks Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Crescent Forgings Co., Oakmont, Pa.
Marshall & Huschart Machinery Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Handles, Machine Tool
Whitman & Barnes Mfg. Co., Chicago, Ill.

Handles, Screw Plate
Standard Welding Co., Cleve., O.

Hangers, Shafting
Cresson Co., Geo. V., Phila., Pa.
Fairbanks Co., New York.
Hyatt Roller Bearing Co., Harrison, N. J.
Link-Belt Engineering Co., Philadelphia, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

Heaters, Feed Water
Sturtevant Co., B F., Hyde Park, Mass.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B F., Hyde Park, Mass.

Heating Machines
Am. Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Hoisting and Conveying Machinery
Alliance Machine Co., Alliance, O.
Brown Hoisting Machinery Co., Cleveland, O.
Case Mfg. Co., Columbus, Ohio.
Caldwell & Son Co., H. W., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machy. Co., New Haven, Conn.
Jeffrey Mfg. Co., Columbus, O.
Lamson Consolidated S. S. Co., Boston, Mass.
Link-Belt Engineering Co., Philadelphia, Pa.
Main Belting Co., Phila., Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
United Engineering & Fdry. Co., Pittsburg, Pa.

Hoists, Electric
C & C Electric Co., New York.
Case Mfg. Co., Columbus, Ohio.
Cleveland Crane & Car Co., Wickliffe, O.
Crocker-Wheeler Co., Ampere, N. J.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Frevert Machinery Co., New York.

Hoists, Electric—*Continued*
General Electric Co., New York.
General Pneu. Tool Co., Montour tour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand
Case Manufacturing Co., Columbus, Ohio.
Chisholm & Moore Mfg. Co., Cleveland, O.
Frevert Machinery Co., New York
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Moore Co., Franklin, Winsted, Conn.
Nicholls, Wm. S., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chisholm & Moore Mfg. Co., Cleveland, Ohio.
Curtis & Co. Mfg. Co, St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Northern Engineering Works, Detroit, Mich.

Hose, Steel
Sprague Elec. Co., New York.

Igniters, Gas Engine
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Indicators, Speed
Niagara Tachometer & Inst. Co., Niagara Falls, N. Y.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral
Warner Instrument Co., Beloit, Wis.

Indicators, Steam Engine
Crosby Steam Gage and Valve Co., Boston, Mass.

Indicators, Test
Equipoise Rivet Co., Waterbury, Conn.
Norton Emery Wheel Co., Worcester, Mass.

Industrial Railways
Hunt Co., C. W., West New Brighton, N. Y.

Injectors
Desmond-Stephan Mfg. Co., Urbana, O.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspecton and Tests
Hunt Co., Robert W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence

Instruments, Electric
General Elec. Co., New York.
Stanley-G. I. Electric Mfg. Co., Pittseld, Mass.

Iron Filler
Clark Cast Steel Cement Co., Shelton, Conn.
Felton, Sibley & Co., Phila., Pa.

Jacks, Hydraulic
Bethehem Fdry. & Mach. Co., So. Bethlehem, Pa.
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Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Kettles, Soda
Brown & Sharpe Mfg Co., Providence, R. I.

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Barnes Co., B. F., Rockford, Ill.
Chattanooga Mchry. Co., Chattanooga, Tenn.

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Marshall & Huschart Machy. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Gauge Steel Co., Beaver, Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knives, Shear
Phillips-Laflitte Co., Philadelphia, Pa.

Knurls
Hammacher, Schlemmer & Co., New York.

Lamps, Arc
General Electric Co., N. Y. City.
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent
General Elec. Co., New York.
Stanley-G. I. Electric & Mfg. Co., Pittsfield, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

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American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bowers, E. J., Philadelphia, Pa.
Bradford Machine Tool Co., Cincinnati, Ohio.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Sloan & Chace Mfg. Co., Newark, N. J.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Hill Standard Mfg. Co., Anderson, Ind.
LeCount, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

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American Tool Works Co., Cin., O.
Automatic Mach. Co., Bridgeport, Conn.
Barnes Co., W. F., & John, Rockford, Ill.
Bertram & Cons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport Conn.
Champion Tool Works Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Diamond Machine Co., Providence, R. I.
Dreses Mach. Tool Co., Cincinnati, O.
Fairbanks Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Conn.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Machry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.

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Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sellers & C., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Springfield Mch. Tool Co., Springfield, Ohio.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Walcott & Son, Geo. D., Jackson, Mich.
Wells & Sons Co., F. E., Greenfield, Mass.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark Tool Co., Waltham, Mass.
Sloan & Chace Mfg. Co., Newark, N. J.
Waltham Machine Works, Springfield, Mass.
Waltham Watch Tool Co., Springfield, Mass.

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Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
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Nicholson & Co., W. H., Wilkes-Barre, Pa.

Mandrels, Solid
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Independent Pneumatic Tool Co., Chicago, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
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Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

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Dwight Slate Machine Co., Hartford, Conn.

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Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.

Mechanical Draft
Sturtevant Co., B. F., Hyde Park, Mass.

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Besly & Co., Chas. H., Chicago, Ill.
Lumen Bearing Co., Buffalo, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.

Meters, Electric
General Electric Co., New York.
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

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Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles-Bement-Pond Co., New York
Rivett Lathe Mfg. Co., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Niles-Bement-Pond Co., New York
Rivett Lathe Mfg. Co., Boston, Mass.
Waltham Mach. Tool Co., Springfield, Mass.

Milling Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Horizontal
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Cincinnati Milling Machine Co., Cincinnati, O.
Hendey Mach. Co., Torrington, Ct.
Hess-Bright Mfg. Co., Phila., Pa.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Kempsmith Mfg. Co., Milwaukee, Wis.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York
Pratt & Whitney Co., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Milling Machines, Plain
Adams Co., Dubuque, Iowa.
American Tool Wks. Co., Cin., O.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
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Becker-Brainard Milling Machine Co. Hyde Park, Mass.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.

Milling Machines, Universal —*Continued.*
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Conn.
Kempsmith Mfg. Co., Milwaukee, Wis.
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Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Adams Co., Dubuque, Iowa.
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Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Garvin Mach. Co., New York.
Ingersoll Milling Mach. Co., Rockford, Ill.
Newton Mach. Tool Works, Philadephia, Pa.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

Milling Tools, Adjustable
Geometric Tool Co., New Haven, Conn.
Rogers Works, John M., Gloucester City, N. J.

Mining Machinery
Ingersoll-Rand Co., New York.

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Gould & Eberhardt, Newark, N. J.
Link-Belt Engineering Co., Philadelphia, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Molding Machines
Adams Co., The, Dubuque, Iowa.
Mumford Co., The E. H., Philadelphia, Pa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Mortising Machines, Chain
New Britain Mach. Co., New Britain, Conn.

Motors, Electric
Bell Elec. & Mfg. Co., New York.
Burke Electric Co., Erie, Pa.
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Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., Elizabethport, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Independent Pneumatic Tool Co., Chicago, Ill.
Jantz & Leist Elec. Co., Cin., O.
Northern Electrical Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. Co., Chicago, Ill.
Sprague Electric Co., New York.
Stanley-G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

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Baker Bros., Toledo, Ohio.
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Rowbottom Machine Co., Waterbury, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

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Reed Mfg. Co., Erie, Pa.
Saunders Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer Attachments
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Planers
American Tool Wks. Co., Cin., O.
Bartlett, E. E., Boston, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
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Cleveland Planer Works, Cleveland, O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia Pa.
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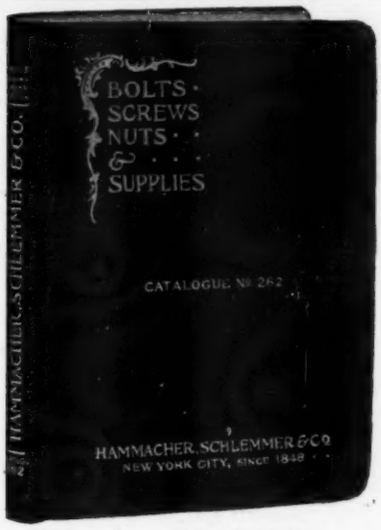

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Watson-Stillman Co., New York.

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Miner & Peck Mfg. Co., New Haven, Conn.
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Swaine Co., Fred J., St. Louis, Mo.

Presses, Foot and Hand
Bliss Co., E. W., Brooklyn, N. Y.

Presses, Forging
Niles-Bement-Pond Co., New York.

Presses, Hand
Swaine Co., Fred J., St. Louis, Mo.

Presses, Hydraulic
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Chambersburg Engineering Co., Chambersburg, Pa.
Elmes, Chas. F., Eng. Works, Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Watson-Stillman Co., New York.

Presses, Power
American Tube & Stamping Co., Bridgeport, Conn.
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Dill Machine Works, T. C., Philadelphia, Pa.
Fairbanks Co., New York.
Lucas Mach. Tool Co., Cleve., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Swaine Co., Fred J., St. Louis, Mo.
Truesdale & Co., S. B., Rochester, N. Y.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Presses, Screw
Barnes Co., W. F. & Jno., Rockford, Ill.

Profilers
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

Publishers
Henley Pub. Co., Norman W., New York.

Pulleys
American Pulley Co., Phila., Pa.
American Tool & Machine Co., Boston, Mass.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Rockwood Mfg. Co., Indianapolis, Ind.
Sellers & Co., Wm., Phila., Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.
Wilmarth & Morman Co., Grand Rapids, Mich.

Pulley Turning and Boring Machines
American Tool Wks. Co., Cin., O.
Bertram & Sons, Ltd., John, Dundas, Ontario, Canada.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Pumps, Air
Ingersoll-Rand Co., New York.

Pumps, Electric
General Electric Co., New York.

Pumps, Hydraulic
Elmes, Chas. F., Eng. Works, Chicago, Ill.
General Electric Co., New York.
Watson-Stillman Co., New York.

Pumps, Steam
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.

Punches, Centering
Brown & Sharpe Mfg. Co., Providence, R. I.
Hammacher, Schlemmer & Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Punches, Hand
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Punches, Hydraulic
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Niles-Bement-Pond Co., New York.
United Engineering & Fdry. Co., Pittsburg, Pa.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.

Rack Cutting Machines
Adams Co., Dubuque, Iowa.
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Walcott & Son, Geo. D., Jackson, Mich.

Racks, Cut
Boston Gear Wks., Boston, Mass.
Cleveland Wire Spring Co., Cleveland, O.
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
LeBlond Mach. Tool Co., R. K., Cincinnati, Ohio.
Nuttall Co., R. D., Pittsburg, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Radiators, Japanning Oven
American Gas Furnace Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Stark Tool Co., Waltham, Mass.

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Chadwick, G. B., & Co., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
Gisholt Mach. Co., Madison, Wis.
Hammacher, Schlemmer & Co., New York.
Independent Pneumatic Tool Co., Chicago, Ill.
International High-Speed Steel Co., New York.
Lapointe Mach. Tool Co., Boston, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Schellenbach & Darling Tool Co., Cincinnati, O.
Standard Tool Co., Cleveland, O.
Three Rivers Tool Co., Three Rivers, Mich.
Wells Bros. Co., Greenfield, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.
Wiley & Russell Mfg. Co., Greenfield, Mass.

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Ingersoll-Rand Co., New York.

Recorders, Speed
Niagara Tachometer & Inst. Co., Niagara Falls, N. Y.

Rheostats
Crocker-Wheeler Co., Ampere, N.J.
General Electric Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Rims and Bands
Standard Welding Co., Cleve., O.

Rings, Chuck and Gear
Standard Welding Co., Cleve., O.

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Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Chisholm & Moore Mfg. Co., Cleveland, O.
General Pneumatic Tool Co., Montour Falls, N.Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Riveters, Steam
Chambersburg Engineering Co., Chambersburg, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Riveting Machines
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Roller and Ball Bearings
Auburn Ball Bearing Co., Rochester, N. Y.
Boston Gear Wks., Boston, Mass.
Hess-Bright Mfg. Co., Phila., Pa.
Hyatt Roller Bearing Co., Harrison, N. J.

Roller Mills, Coining
Dill Mach. Works, T. C., Philadelphia, Pa.

Rolling Mill Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Dill Mach. Works, T. C., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburg, Pa.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Rules, Steel
Billings & Spencer Co., Hartford, Conn.
Hammacher, Schlemmer & Co., New York.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

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Crosby Steam Gage and Valve Boston, Mass.

Sand Blast Apparatus
Drucklieb, C., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadelphia, Pa.

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Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Saw Sharpening Machines
Cochrane-Bly Co., Rochester, N. Y.
Nutter, Barnes & Co., Boston, Mass.

Sawing Machines, Metal
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Cochrane-Bly Co., Rochester, N. Y.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Nutter, Barnes & Co., Boston, Mass.
Tabor Mfg. Co., Phila., Pa.
Tindel-Morris Co., Eddystone, Pa. Pa.
United Enginering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood
Colburn Mach. Tool Co., Franklin, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

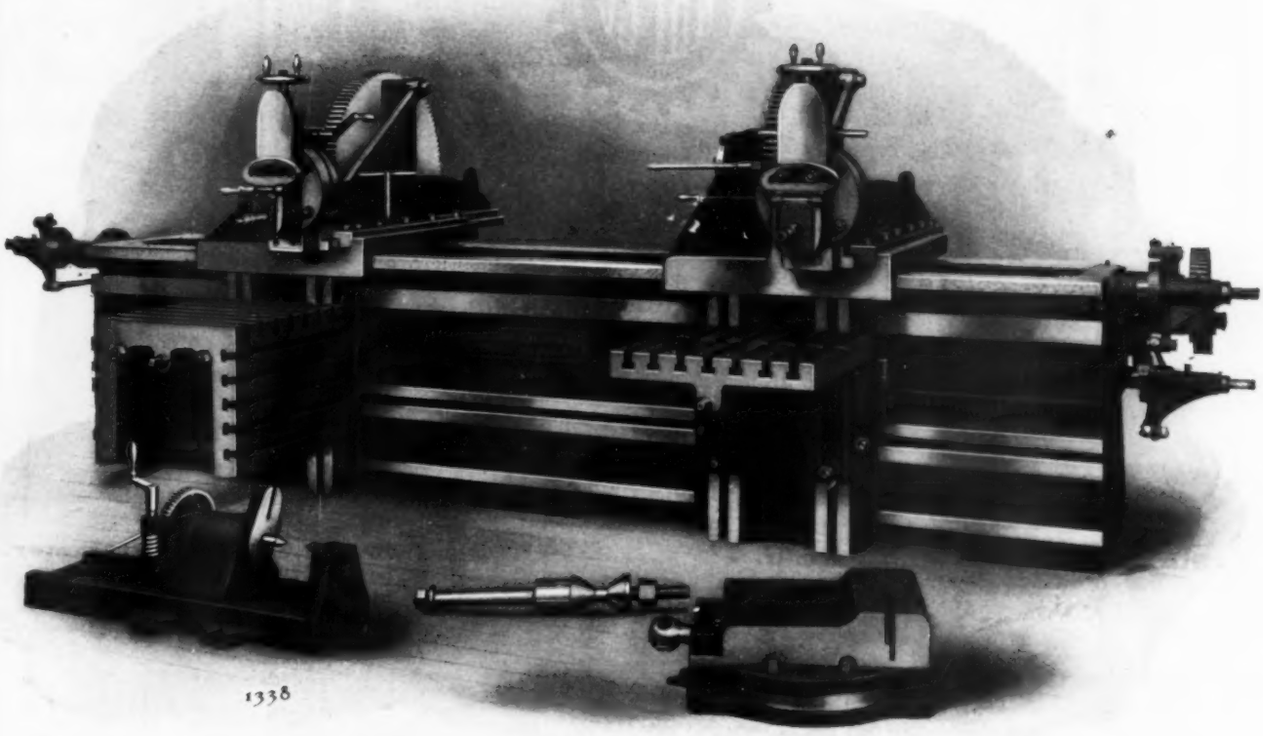
Saws, Hack Power
Diamond Saw & Stamping Works, Buffalo, N. Y.
Fairbanks Co., N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
Niles-Bement-Pond Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Saws, Metal Band
Greaves, Klusman & Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Schools, Correspondence
American School of Correspondence, Chicago, Ill.
Bliss Electrical School, Washington, D. C.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
Michigan College of Mines, Houghton, Mich.

TRAVELING HEAD SHAPERS



26-inch Bement Double Head Shaping Machine—motor driven

In shops where much heavy work is done the traveling head shaper is an extremely useful tool. It may be provided with various attachments, including index centers, vise and cone arbor. Early deliveries.

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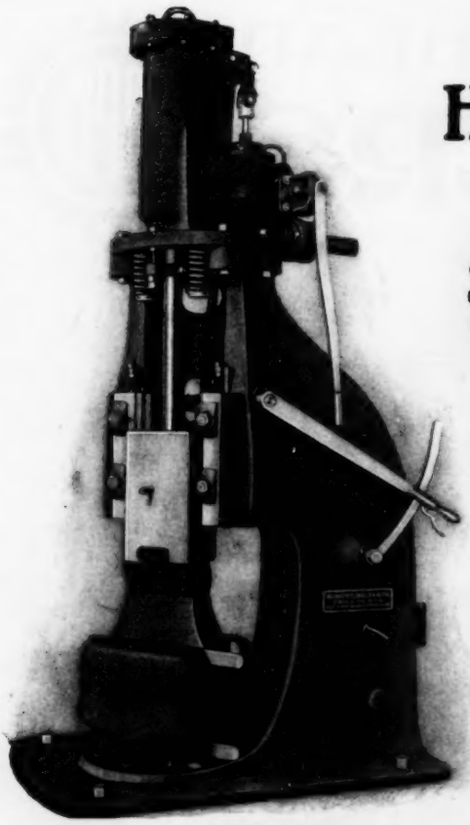
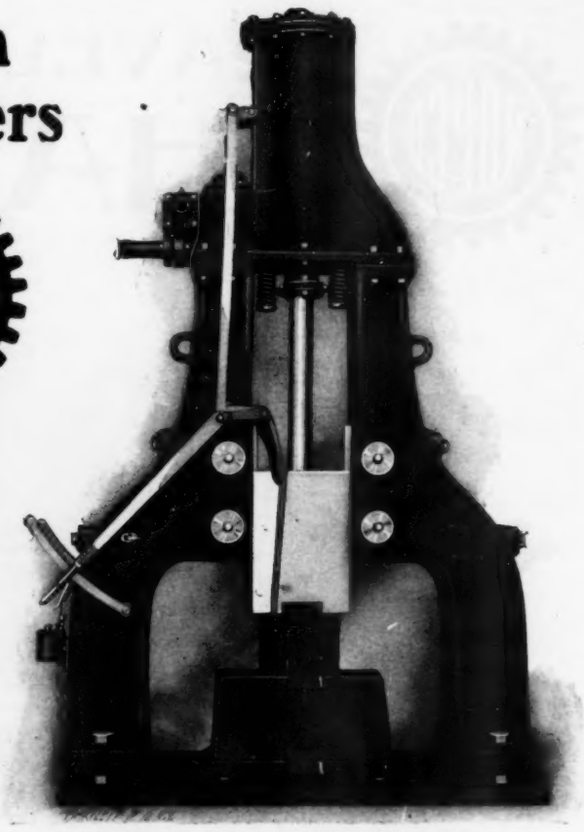
Steam Hammers



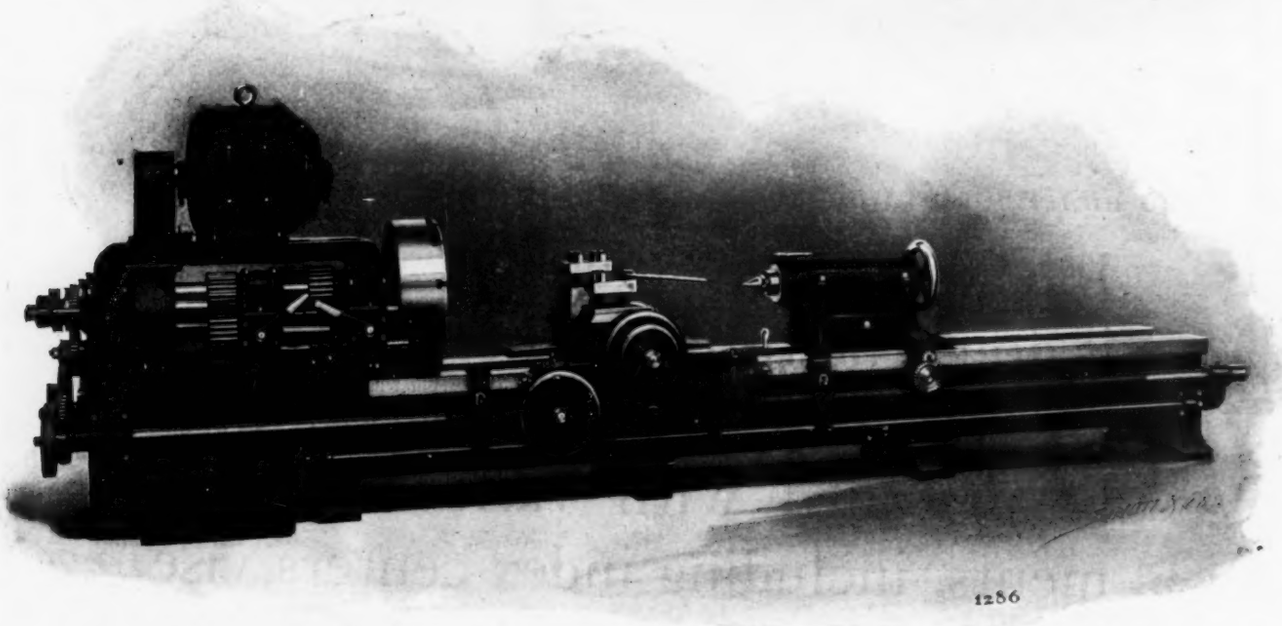
Single Frame Steam Hammer.

All kinds and sizes from 250 pounds to 30,000 pounds falling weight, fully covering all the requirements of modern forge practice.

Send for Steam Hammer Catalog.



Double Frame Steam Hammer.



30-Inch Rapid Reduction Lathe for use with High Power Tool Steels.

NILES-BEMENT-POND COMPANY,

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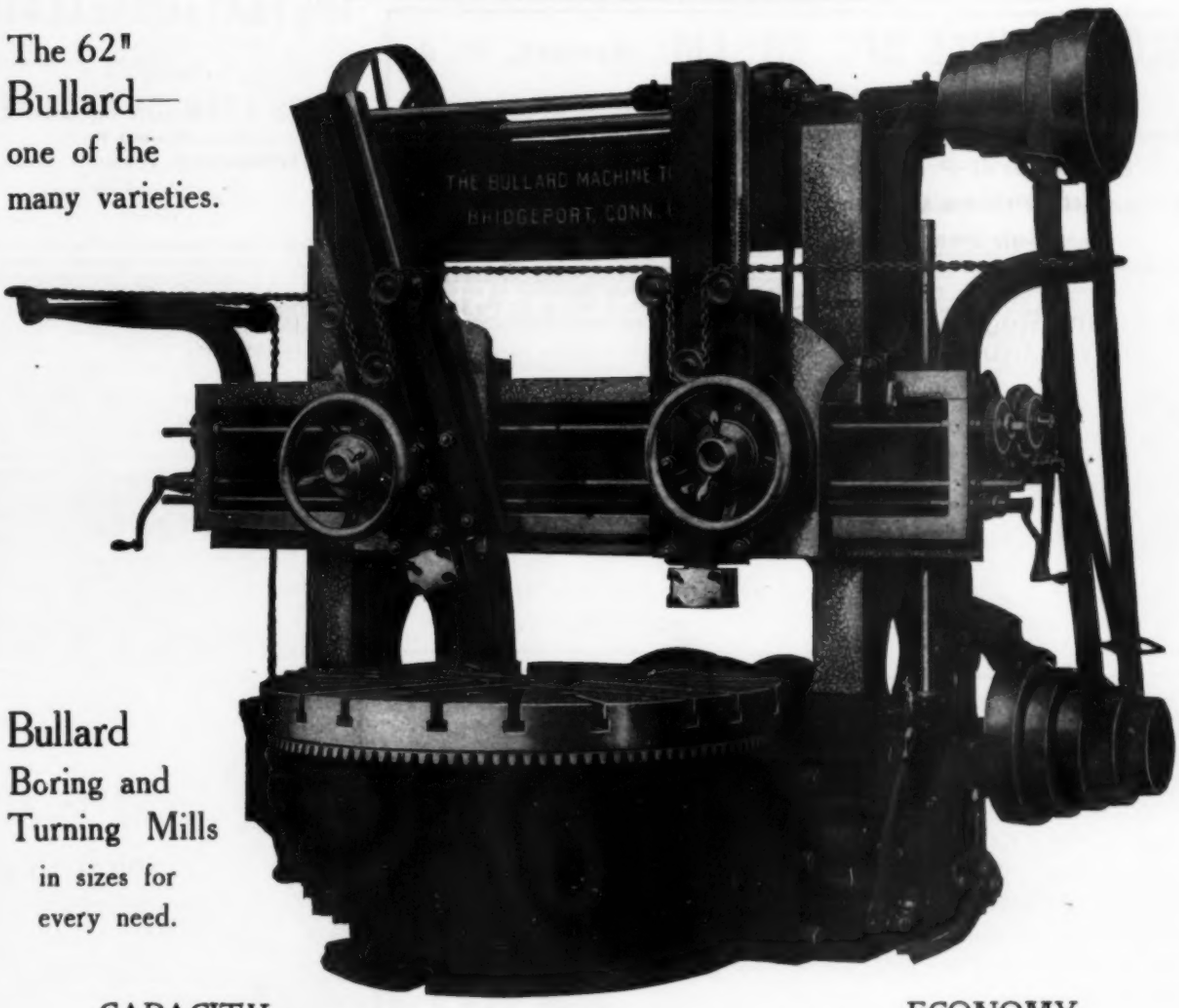
THREE ESSENTIAL FEATURES THAT REACH THEIR HIGHEST DEVELOPMENT IN BULLARD MILLS.

The 62" Bullard— one of the many varieties.



Bullard Boring and Turning Mills in sizes for every need.

CAPACITY.

A "Bullard" can take as heavy a cut as the best of high-speed steels will permit. No matter how heavy or cumbersome your work, you can't strain or jar a "Bullard." Work of 62" dia., which is difficult to handle on a lathe, is easily and accurately cared for on a 62" "Bullard." It can work anything you can put on the table—and the table can't tip.

SPEED.

You can cut as fast as your steel will stand. The cross-rail can be raised and lowered by power. The table can be stopped instantly at any point with brakes. With the mechanical belt shifter you can make rapid changes of speed under a full load.

ECONOMY.

The rapidity, accuracy and ease with which a "Bullard" runs—the incased, well-lubricated gears—and the many safety, mechanical, time and labor-saving devices that it has—make it the most economical of all Boring and Turning Mills.

For convincing reasons as to why you should use the "Bullard" send for "Catalog 30."

The Bullard Machine Tool Co.

530 Broad Street, BRIDGEPORT, CONN., U. S. A.

AGENTS—Marshall & Huebart Machinery Co., Chicago, Ill. The Motch & Merryweather Machinery Co., Cleveland, O. Chas. G. Smith Co., Pittsburg, Pa. The C. H. Wood Co., Syracuse, N. Y. Harron, Rickard & McCone, San Francisco, Cal. The Crane Co., Birmingham, Ala. Williams & Wilson, Montreal, P. Q. Chas. Churchill & Co., Ltd., London, E. C., England. Fenwick Freres & Co., Paris, France. Heinrich Dreyer, Berlin, Germany.

Bevel Gears

are cut by me theoretically correct, and so are adapted to fine machinery of all kinds. I have special facilities for cutting SPUR, WORM, SPIRAL, MITRE and INTERNAL wheels. Let me quote on your specifications.

Special Machines for Cutting Bevel Gearing.

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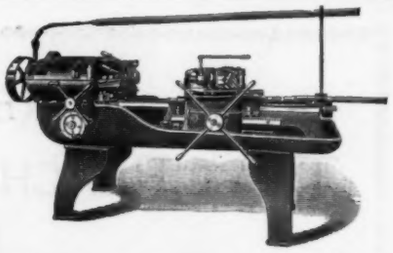
Agents for Italy: Ing. Vaghi, Accornero & Co., Milano.



THE FLAT TURRET LATHE.

Now built in two sizes: 2x24—12" swing, and 3x36—14" swing. Equipped with tools for either bar or chucking work.

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Main Office and Works:

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Lieber's Code used.

See Our Advertisement on Pages 12 and 13.

SLOAN & CHACE MFG. CO., Ltd., Newark, N. J.

MANUFACTURERS OF

Bench Lathes and Attachments, Bench Milling Machines, Bench Drill Presses, Bench Tapping Machines, Automatic Pinion Cutters, Automatic Gear Cutters, Sub Press Dies and Special Tools.

The Acme Machinery Co.,

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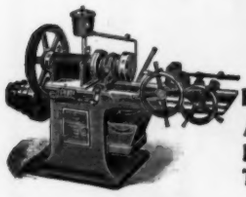

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ACME BOLT and RIVET HEADERS

Acme Single, Double and Triple.

Automatic Bolt Cutters. Cutting from 1-8 in. to 6 in. in diameter.

Also Separate Heads and Dies.

Don't Start A Shop

If you are thinking of starting the manufacture of any mechanical specialty, we can make it cheaper and perhaps better with our complete plant than you could with a less complete shop. **Write us about it.**

The Blanchard Machine Co., 64 State Street, Cambridge, Mass.

TEXT-BOOK ON MECHANICS STATICS, VOL. 1.

By Louis A. Martin, Jr., M.E., A.M., Stevens Institute.

12mo, Cloth, $1.25 net.

JOHN WILEY & SONS,

43 and 45 East 19th Street NEW YORK CITY.

"High Duty Boring Machines"

THE BINSSE MACHINE CO., NEWARK, N. J.

Have you ever had that queer feeling

in your back that comes from bending over a planer all day trying to examine your work from the front side of the table? If you haven't, you will hardly appreciate what a boon the Gray duplex shifter mechanism is to the tired workman. It enables him to start and control the cut from either side of the planer, and so saves the backache and the time usually spent in running from one side of the machine to the other.

There are other labor and time saving features illustrated in the catalogue which is free for the asking.

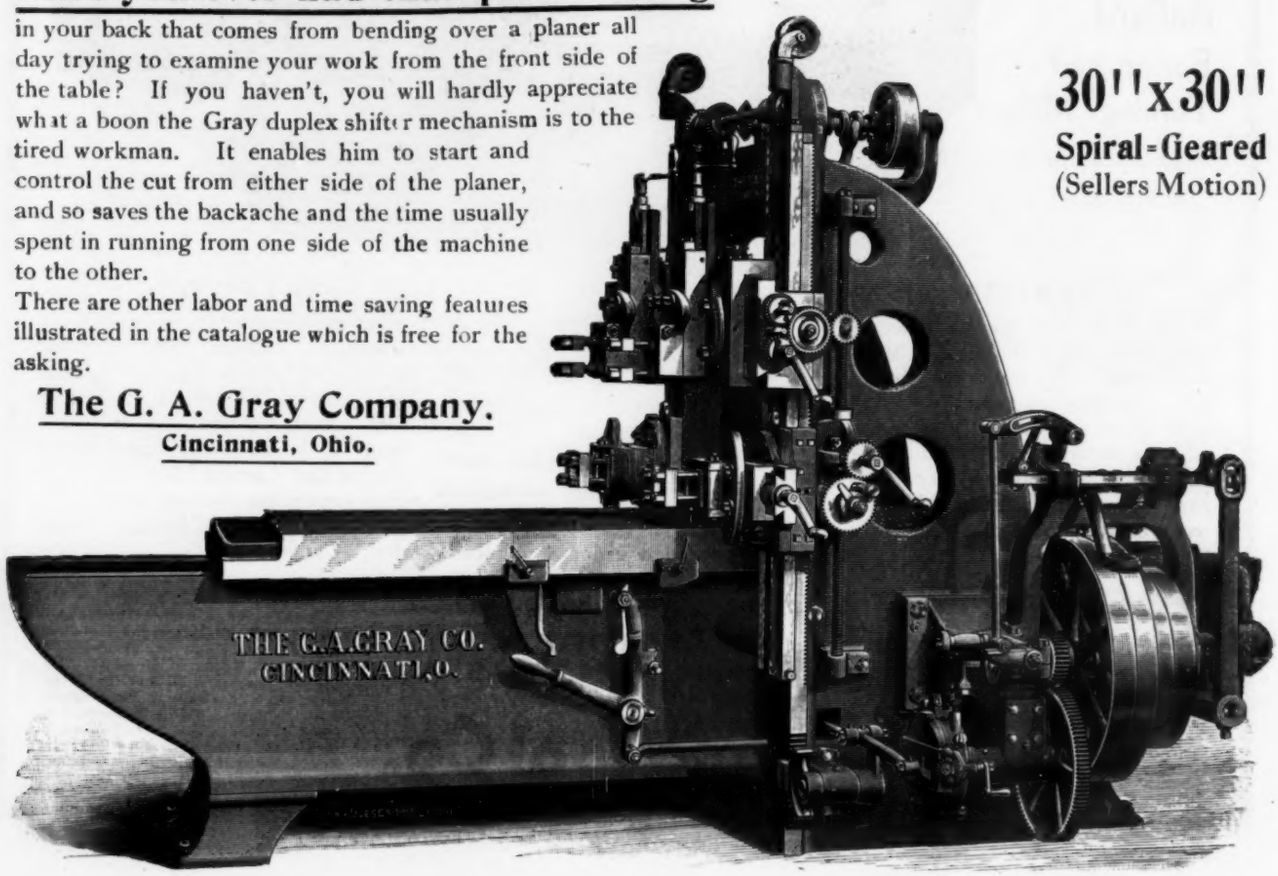
The G. A. Gray Company.

Cincinnati, Ohio.

30"x30"

Spiral-Geared

(Sellers Motion)



A French Motor-Car Works.

BY L. RAMAKERS.

One of the most interesting examples of the building up of a motor-car works is to be found in the history of Panhard & Levassor, the largest motor car manufacturers of France. The works in the Avenue d'Ivry, at Paris, are the outgrowth of a small plant taken over in 1853 for the manufacture of wood-working machinery, and now cover an area of ten acres, exclusive of large repair shops covering 2 acres which have been erected in close proximity. Last year a weaving factory was purchased at Reims with about 10 acres of land and shops covering 1½ acres and since the beginning of last year these

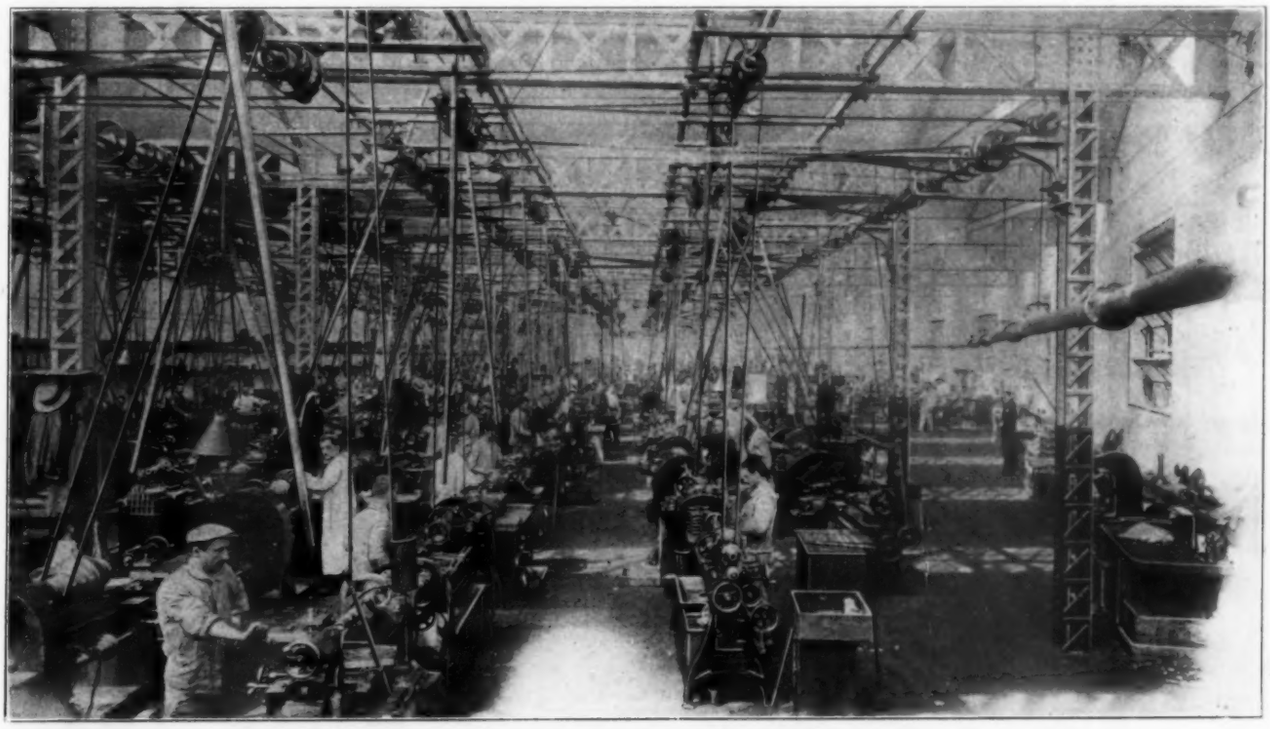


FIG. 1. VIEW IN MACHINE SHOP.

works have been manufacturing for Paris. At the Paris factory about 1600 hands are employed, and 1500 cars are turned out a year.

The development of the works has proceeded along systematic lines. The firm very soon recognized the importance of training workmen in the branches of manufacturing and fitting, and this work of training is still an important feature of the Avenue d'Ivry organization. A man who learns his trade in the works becomes a permanent unit. Until recently the apprentices were distributed among the different shops, but as the law does not allow apprentices to work more than ten hours a day, and as it has been necessary in times of pressure to keep the works running twelve hours, their presence was often a source of inconvenience. A separate shop has therefore been erected where about twenty apprentices are employed.

Originally, the Panhard works consisted of two shops for the manufacture of wood-working machinery, and this branch of the industry is still carried on. Between the wood-working machinery shop and the extensive offices are a warehouse, a dispensary and reception rooms for visitors. Farther on is the carpenter's shop, where there is a large installation of band-saw machines for traveling tables for cutting the wood in lengths for frames, spokes and felloes, also a particularly interesting machine for shaping the spokes. This is one of the old shops where space has to be economized in every possible way, and to facilitate work an electric traveling crane is in course of erection. It should be remarked that there is a considerable store of wood, principally oak and acacia, the latter for the spokes, which is left to season for some years. At the rear of these buildings are two large bays built entirely of steel and cement, well lighted by windows running down each side, and, even at the end of a day's work, looking remarkably clean and neat. One of these shops is devoted to the manufacture of motors, and the other to transmissions. The motor bay, Fig. 1, has a length on one side of 435 feet, and on the other of 750 feet, while the width is 90 feet. The other bay is slightly larger. In these two shops there are something like 600 machine tools driven from overhead shafting. The tools are mostly of standard types, and in very few cases has it been found necessary to modify them for special work. They are drawn from all countries, but principally from America and England; the cold saws are manufactured by the firm itself.

Such parts as cylinders and crank chambers are placed in jigs, while bolt-holes in flanges and lugs are drilled, so that all these heavier parts are assembled without trouble. The aluminum castings are clean and are generally so accurate that after simply planing the faces, the edges assemble very neatly, and need no chiseling or filing. The aluminum has a small percentage of alloy which does not add materially to its weight, and the metal is said to have the same resistance as cast iron. One end of the motor shop is boarded off into two compartments. In one of these new inventions are carefully investigated, and drawings are made of new motors and mechanisms, and in the other these devices are constructed. The transmission shop has a similar equipment for turning out gear wheels, shafts, differentials and the like.

From here we pass into the motor-testing shop, where every engine is coupled to a dynamo and tested. The casting carrying the field magnets is hinged, and to this is attached a rod with a weight. The length of the rod and the weight are calculated according to given formulas to balance the torque of the dynamo when the e.m.f. is equal to the power that should be developed by the engine. This power is indicated by a slight rising of the weight. It is, in fact,

an electrical application of the Prony brake. Each bench has a switchboard, provided with volt and ampere meters. The dynamo can also be put in circuit with a resistance board, having a considerable number of incandescent lamps which can be switched on to vary the load on the engine. When about twenty engines, ranging in power up to 50 horsepower, are running on the benches, it is obvious that a considerable amount of energy is developed in the testing bay. This is sent to the mains for distribution throughout the works, so that when the testing bay is in full operation the steam engines are running very light. It is through the testing and erecting shops that the apprentices and new hands pass before being put to other work, and there is always a limited number of mechanics spending some time in these shops, so as to be qualified for undertaking repairs at agencies in France and abroad.

Similar in construction to the shops already described is the chassis erecting bay, Fig. 2, where the engines and transmissions are fitted to the chassis. Each staff of workmen has a number corresponding with the chassis, and it is then known by whom each chassis is adjusted. There is no littering about of tools; files, wrenches, saws, calipers, etc., are neatly kept in their places on a board behind each staff of hands. All this means time saved, while it gives an orderly appearance to the shop.

On leaving the erecting bay each chassis is taken to the adjusting shop, to be provided with ignition apparatus, radiator, bonnet, and chains, as well as a temporary body, and is then run on a 300-meter track. If this running test proves satisfactory the chassis is taken to the finishing shop, and put into shape to be sent away to the coach-building factories. Exhaust pipes and silencers are fitted to the engines, water connections are made, the dashboards are fixed with their lubricators and gages, and the final finish is given to the complete chassis. On an average five cars a day pass through this shop, but in busy times as many as eight are completed.

From the finishing shop we enter a laboratory, where metals are tested, experiments carried out with new alloys, and researches made generally into anything that may add to the efficiency of the various metals employed in motor-car construction. Adjoining these buildings is the original shop that more than half a century ago comprised nearly the whole of the works acquired by M. Perin. Here the manufacture of band saws and machine tools is still carried on, as well as the machining of the heavier motor car parts. Shafts are turned in this shop and big gear wheels cut. This shop is crowded with heavy machinery, and the firm intends re-arranging this part of the works so as to be able more effectively to cope with the increasing business. In the engine room two Corliss engines drive the dynamos which generate current for power and lighting. Nearly the whole of one side of the room is occupied by a switch-board and the whole installation is very neat and clean.

In the same group of buildings is to be found the wood pattern shop, the cementation plant, and the shop for apprentices. One of the most interesting parts of the works is the store, which controls the operations throughout the factory. In this department is a complete system of gages and templates, with which every part is examined two or three times during the process of manufacture. In the case of a gear wheel, for instance, the piece of nickel steel from which it is to be cut passes from the store to the transmission bay, where the teeth are cut, then returns to the store, and after inspection is sent to the cementation ovens, returning again to be finally inspected. Here, also, is a laboratory equipped with machines for testing metals for tensile and crushing strength. Samples of all new consignments of metal are treated in this way so as to ensure that the material employed is of a homogeneous quality.

FIG. 2. CHASSIS ERECTING BAY.

The International and Industrial Exhibition and Sale Company, of Amsterdam, has issued a circular stating that it has organized a permanent exhibition in that city for the display of industrial products from all countries. The exhibition building and main offices of the company are situated on the site of the International Exhibition of 1892, the location being such that exhibitors' goods may be conveniently transported by water. The building covers an area of about 22,000 square feet and is provided with the necessary electrical power, gas and water. In addition to the space reserved for exhibits, there are reading and reception rooms for the convenience of manufacturers and buyers. Particulars regarding space, rates, etc., may be obtained from the American representatives, C. C. Abel & Co., 116 Broad street, New York.

A Perforating Press.

In mining, sugar making, laundry work, grain sorting, coffee grading and countless other industries screens of various degrees of fineness are used in enormous quantities. Woven-wire screens have been and are still used to a great extent, however, their use is rapidly decreasing owing

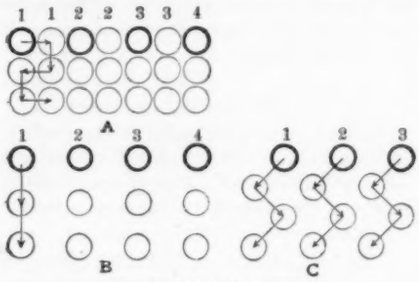


FIG. 1. SHOWING FEEDS.

to the adoption of perforated screens. The reasons for this are numerous. The woven-wire screen does not permit the material to pass readily over it, the wires are liable to be displaced, the friction of the material striking the high ridges wears the woven screen rapidly, once a break occurs in a woven screen the whole screen has to be replaced, and in so-called "trommels" or drum-shaped screens the pitch of the trommel has to be great, say 1 in 4, to permit the material to travel over it. This increase in pitch necessitates a slower rotary motion in order to obtain good results and a consequent decrease in the amount of material handled in a given time. On the other hand the perforated screen permits the material to pass readily over it; the metal between holes cannot become displaced; there are no high portions presented to the material which invite wear; when a break occurs it is easily repaired; owing to the lack of projections the pitch of trommels may be decreased to 1 in 7 or 8 and the rotary speed may be increased; further the perforated screen can be made with any width of plain margin, while the woven screen cannot.

In perforated metal the holes vary from 0.020 inch diameter for brass or copper sheets No. 24 American gage, or thinner, up to, say, 1¾ inches, for coal or coke, and of suitable thickness of plate, say ¼-inch steel.

The perforations may be made any desired shape, whether for ornament or to serve some practical purpose in selecting and separating material of certain shape. Thus in machines for grading coffee some of the screens have oval and others round holes. Contrary to what one would expect the long oval coffee beans drop through the round holes and the quasi-spherical beans drop through the oval holes. The sorting is done after roasting and a bag of coffee that was grown in, say, Demerara when sorted into large oval, small oval, large round and small round, with a grade of oval oversize that will not pass through the largest round holes and an oversize of round that will not pass through the largest oval holes, is sold under six different names ranging from "Old Government Java," for the large oval to "Mocha," or "Peaberry Maracaibo," for the small twisted quasi-spherical berries, and so on, so that one does not know where his coffee comes from, but as long as it "tickles the palate"—as a subway coffee sign reads—what's the odds?

In order to understand the reason for some of the movements of the machine which will be described further on, I have shown at Fig. 1 three perforated plates *A*, *B* and *C* illustrating three different feeds, it must be understood that the machine is not limited to these three feeds, many others being obtainable.

The heavily shaded rings show the spacing of the dies and punches, the holes in *A* being obviously too close to give sufficient support to the die if they were punched a whole row at a stroke. The arrows show the order in which the holes are punched and, of course, the reverse of the travel of the plate under the punches.

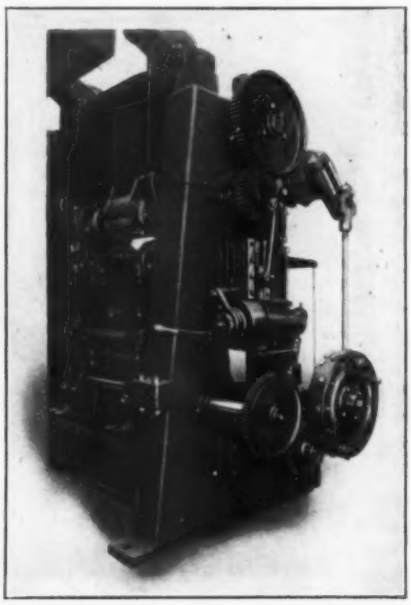


FIG. 3. SHOWING THE FEED.

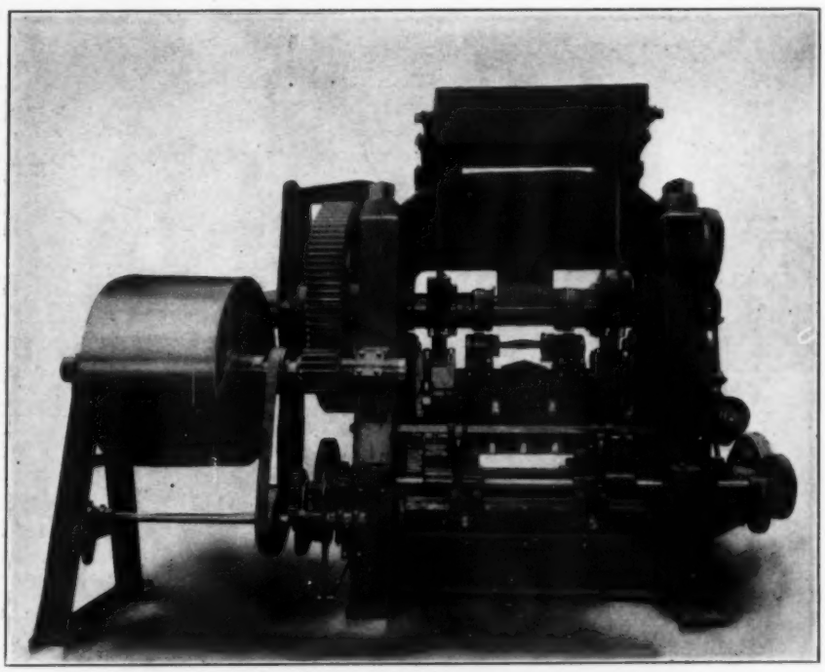


FIG. 2. FRONT VIEW OF THE PRESS.

Fig. 2 shows the front of the new perforating press which has recently been completed by the E. W. Bliss Company, of Brooklyn, New York. This machine will handle plates up to 60 inches wide, ¼ inch thick, or less, and any length. The machine was designed in proportion to an 8-inch steel shaft and allowing a factor of safety of 4 will punch 120 5/16 inch holes through ¼ inch steel at one stroke.

Referring to Fig. 2 the driving pulleys are shown to the left. The one at the extreme left is for moving the press by hand; it has a number of holes drilled in its periphery for inserting a lever. The pulley next to it is the tight pulley proper, it is similar in size and weight to the one just mentioned, i.e., 50 inches diameter by 10½ inches face, these pulleys also serve as flywheels and weigh 1500 lb. each. The loose pulley is to the right. On the same shaft with the pulleys is a pinion which meshes with the large gear on the main shaft of the machine. To the left of the large gear is the clutch lever, shown also in Fig. 4, together with the cylinder which actuates it. This cylinder is of the common slide-valve type operated by hand. Either compressed air or steam may be used as motive power. Referring again to Fig. 2, the feed rolls are seen one pair on either side of the opening under the ram. They grip the edges of the

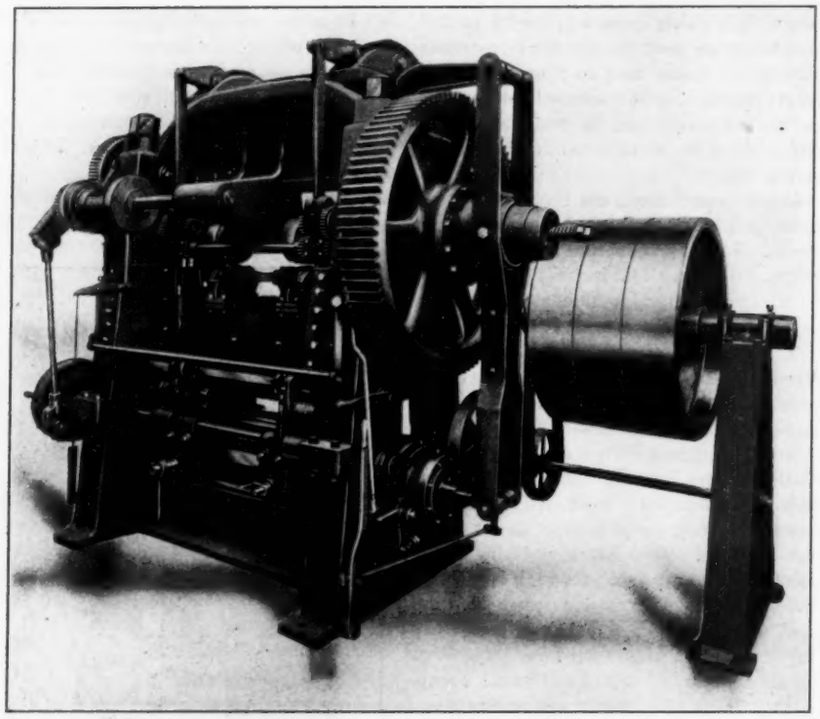


FIG. 4. BACK VIEW SHOWING CLUTCH MECHANISM.

plate only, as do also the feed rolls on the back of the press, this is in order to avoid partially closing the fine perforations as would be the case with feed rolls gripping the whole width of the plate.

The feed rolls are mounted on the bar reaching across the front, a similar arrangement is shown at the back of the press in Fig. 4. The rack below the bar is used for setting the rolls. After they are once set the pinion and handle are disconnected. The bar reciprocates and with it the plate when the work demands that it should do so, either to bring the holes close together or to produce a certain pattern. The bar is actuated by a series of bell cranks and a connecting rod from a slotted disk shown about half way up the left-hand housing in Fig. 5. The rectangular rod reaching across from housing to housing above the feed rolls in Fig. 2 is for lifting the upper feed roll when necessary. It is operated by a hand lever at the side of the housing shown in Fig. 3.

The feed mechanism is by slotted crank shown to the right at the top of Fig. 3. The rod connects with the ratchet gearing enclosed in the round case. Inside this case is a ratchet wheel having a number of pawls of unequal length, one only of these pawls is in contact with a tooth of the ratchet wheel at a time. In this way minute variations of feed are obtainable.

Referring again to Fig. 2, a small pair of pulleys are seen to the left with a belt connecting them, these are always running, whether the main clutch is in or not, so long as the main belt is on the tight pulley. They drive the two grooved friction pulleys, to the left of the left-hand housing, through a train of gears. The large friction wheel in turn drives the feed rolls at a high rate of speed either forward or backward as may be necessary. This high rate of feed is used when entering a new sheet, or removing a partly finished sheet for any reason. When this is necessary the pawls in the regular ratchet feed box are raised by throwing a lever. The quick feed is then thrown in, there is a reverse motion making it operative in either direction. The grooved friction drive is for safety in case any of the pawls of the regular feed happen to be in such position that they cannot lift out of engagement with the ratchet feed.

The opening in the bed from front to back is 3 inches high by 62 inches wide; distance between the uprights 74 inches. The slide has a stroke of 2½ inches and ¾ inch adjustment. The stripper of the machine is actuated by cams and is adjustable.

The adjustments of the slide and the stripper are by means of a pair of pinions mounted on bars having hexagons shaped on their centers, to accommodate a wrench. These two bars with the hexagonal centers can be seen above the slide in Fig. 5. Of course both are provided with devices for locking them when once set.

The ratio of the gearing is 6 to 1. The press makes 50 strokes per minute. The tie rods shown in the illustration are 4 in number of crucible steel 5¾ inches diameter. The floor space necessary is 89x203 inches.

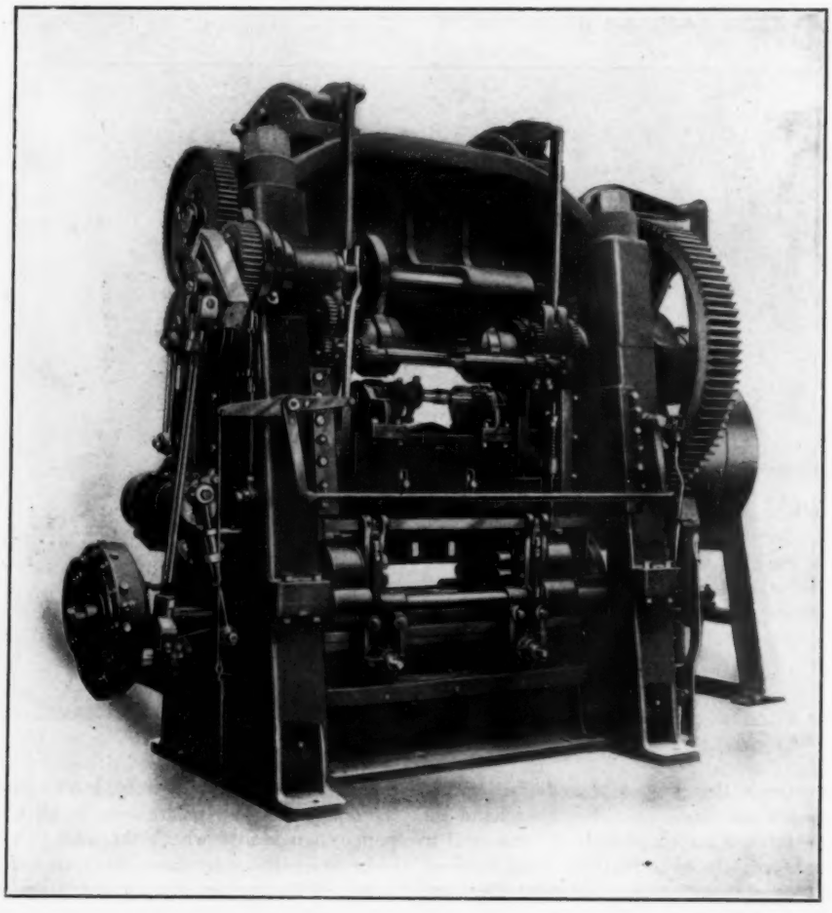


FIG. 5. SHOWING BOTH FEEDS AND ADJUSTMENTS FOR SLIDE AND STRIPPER.

A Drafting Office System.

BY A. JACOBS.

It is an undeniable fact that the methods which in some branches of manufacturing or engineering are extremely efficient, may in other establishments prove almost worthless. Therefore, it is not reasonable to assume that the system which follows would be of value in every drafting room. This system, however, was devised only after a most careful and exhaustive study of the various methods now prevalent in some of the largest and most efficient drafting rooms in the United States, by taking from these several systems those points most suited to meet the conditions at hand, and combining them to form a complete system. This was used experimentally for several months and then thoroughly revised to cover any faults made apparent by its use. Because of its composite nature, its simplicity and conciseness, I feel certain that what follows may at least be used as a basis upon which to build a system to meet the requirements in any drafting room.

What is here presented was devised to meet the requirements in the drafting room of a company largely engaged in the manufacture of automobiles.

Since we have found it more economical to have certain parts of our machines finished by firms specializing in those parts it is absolutely necessary for us to have complete detail drawings of all parts of our machines. These drawings must be so dimensioned as to assure accurate machining to the sizes wanted, thus eliminating unnecessary fitting in assembling the various parts. For this reason, all dimensions for machine operations are in decimals of an inch. Patternmakers' and blacksmiths' figures are in fractions. Each draftsman is supplied with tables of allowances, for fits of various sorts and dimensions on all machine operations are governed, wherever possible, by these tables.

As is usual in most manufacturing establishments, all holes are made standard, and the desired fit is obtained by varying the entering member. All machine-finished surfaces are marked *F*; file finished surfaces are marked *FF*; clearance holes are marked *Drilled*; holes for running or press fits are marked *Ream* or *Grind*, according to the size of the hole and the degree of accuracy required. On all threaded work, even though the United States standard thread may be used, the number of threads per inch is always called for. This has been found to avoid complications in the shops. Whenever a small variation from the nominal dimensions given is possible without injury to the work, the allowable variation is placed beneath the dimension. This limiting of dimensions is placed entirely in the hands of one man who is held responsible for the variations allowed. On all drawings for parts which require several machine operations and the use of several tools or fixtures, the routine of machine work is indicated by placing in one corner of the drawing the various operations to be performed, the order in which they are to be taken up, and the tools or fixtures used for each operation.

SIZE AND ARRANGEMENT OF TRACINGS.

All tracings are made upon one standard size sheet by regular tracers, who do nothing else. This sheet is 20x35 inches, and for small details it is divided by a horizontal or vertical line into two small spaces, or, as is usually the case, by a horizontal line and two vertical lines into six spaces. A blank title plate is printed in each division by means of an electro and an especially prepared quick-drying ink, about one-quarter inch to the left and above the margin line. This allows a margin one-quarter inch wide on all blue-prints. These tracing-sheets are ruled and printed in large quantities, and, after being thoroughly chalked, are placed in drawers to be used as required. In this way the tracings are kept much nearer to scale than if the tracing cloth had been used fresh from the roll. Most of the distortion of tracing-cloth occurs, it has been found, within the first few days after it has been cut from the roll. By this method of cutting the cloth first and ruling it, it is allowed to set so that when it is used there is very little stretch left in it.

When any tracing has been finished on a sheet, a sheet number is assigned to it and placed in the lower right-hand corner,

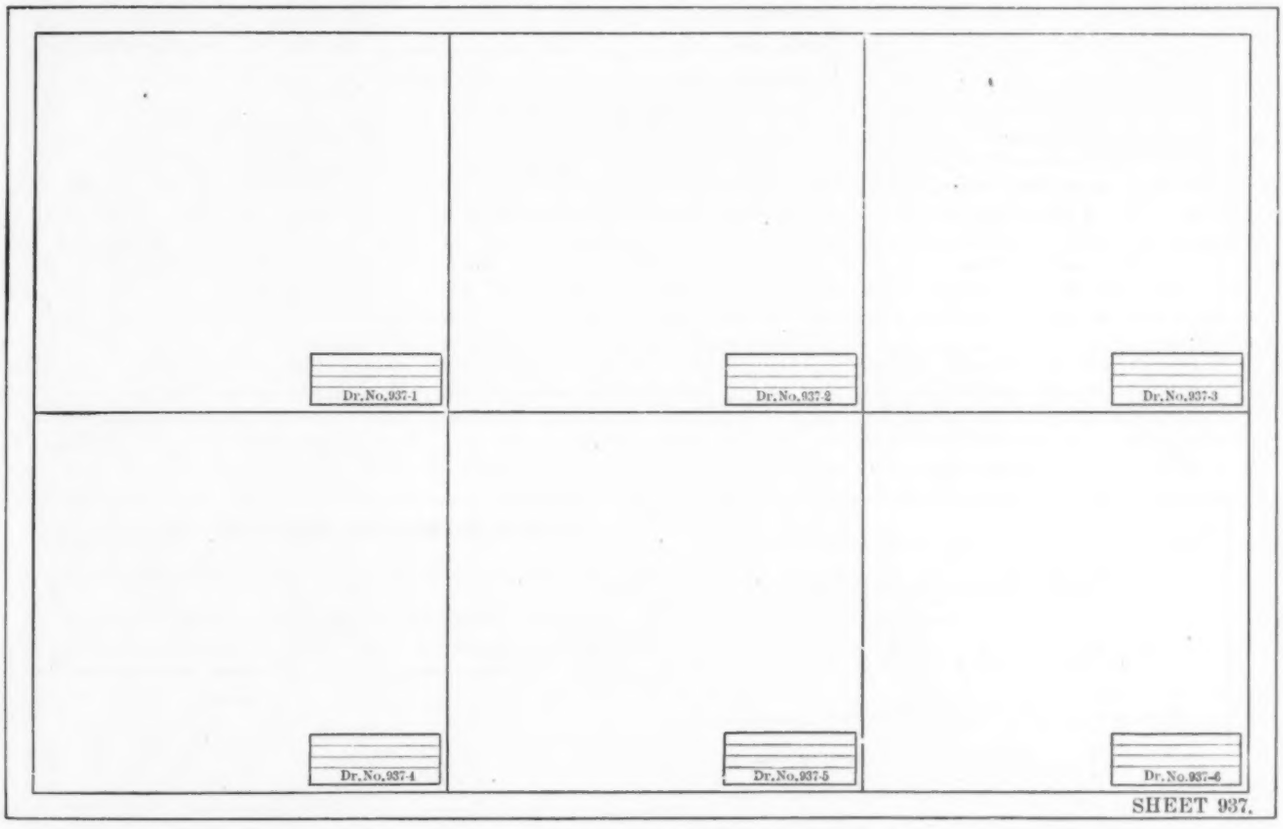


FIG. I. ARRANGEMENT OF TRACINGS AND TITLES.

in a space provided for it in ruling the sheet. This number is used in filing the tracing. Beginning at the upper left-hand space, each division is given a dash number which is preceded in the title plate by the sheet number. This combination forms the drawing number. A sketch of a standard sheet ruled for six spaces is given in Fig. 1 to further illustrate the idea. Piece and pattern numbers are each issued in rotation, independent of each other. To each, however, is prefixed a symbol letter to show upon which model of car the piece is used.

PROVISION FOR CHANGES.

In the event of a change being necessary on a tracing, a blue print is first taken from it, dated and placed in a large folio file provided for this purpose. The change is then made, and the draftsman making it places beneath the altered figure, or whatever else is corrected, a small figure in parenthesis indicating the number of the change. Beneath the title plate, in small characters, this number is duplicated and followed by the date of the correction and the initials of the draftsman making the change. At the same time, the *work-in-progress* card, Fig. 2, is filled out and placed on a file provided for that purpose. For all new work this card is also used and placed upon the same file used for corrections.

The slips in this file pass first to the hands of the checker who checks the drawing or correction, places his mark upon the card and passes it to the chief draftsman for his approval. The chief draftsman then fills out and issues the blue print orders (a sketch of which is shown in Fig. 3) from these work-in-progress cards and in turn places his mark on them and passes them to the stenographer who has charge of the indexing, and the proper entries are made upon the card indexes which will be described later. This renders it absolutely impossible for changes and new work to be overlooked, and shows clearly what prints are to be recalled and what new ones to be issued, so that the work is never held back at any stage, but is carried forward from its first conception to the end.

For details of small parts to be used in experimental work, a copy book with cross-sectioned paper is used. This is arranged to permit of two carbon copies being made from each detail. These are sent to the experimental room, and the original is kept for reference. This book is also used whenever any work is required in too great a hurry to permit of the regulation tracing and blue print being made.

The storing of drawings, tracings and blue prints, as well as the making of the latter, is put entirely in the charge of one person. Whenever a blue print is needed, the blue-print order is filled out and placed upon a file used for that purpose. At regular intervals during the day, all of the prints called for on this file are made and delivered to their proper destination. Each department of the factory, or each outside firm receiving a blue print, must sign and return a receipt for it shown in Fig. 4. In addition to this, every blue print is charged against the department or firm receiving it, on a card provided for this purpose. This card, which is shown in Fig. 5, serves also as a drawing number index and is filed numerically. This enables one to tell at once how many blue prints of any drawing are sent out, and where each one is. In addition to this, the blue print receipts upon their

WORK IN PROGRESS CARD

DRAWING NO._____ PIECE NO._____

CHANGED DIMENSIONS FOR

PATTERN MACHINING NEW

DATE_____ SIGN_____

REMARKS_____

FIG. 2.

_____190__

DELIVER TO_____

_____BLUEPRINTS OF

DRAWING NO._____

_____

RECALL ALL PREVIOUS PRINTS

FIG. 3.

TO_____ DRAWING NO._____

PLEASE SIGN AND RETURN

FROM

SOUTHERN M'F'G CO.

REC'D_____ PRINTS OF DRAWING NO._____

DATE_____ SIGN_____

RETURNED_____

FIG. 4

DRAWING NUMBER AND BLUEPRINT RECORD

PATTERN NO.	PIECE NO.	DRAWING NO.
TITLE		
CORRECTED		

DATE	Number of Prints	SENT TO	RETURNED

FIG. 5

PIECE NUMBER INDEX

PATTERN NO.	DRAWING NO.	PIECE NO.
TITLE		
MATERIAL		

NO. REQ.	FOR MODEL	PATTERN FINISHED
		PATTERN CHANGED

FIG. 6

GENERAL INDEX

NAME

PATTERN NO.	DRAWING NO.	PIECE NO.
SUPERSEDES DRAW. NO.	SUPERSEDED BY DRAW. NO.	
DATE MADE	OBSOLETE	
REMARKS		

FIG. 7

DRAWING OFFICE SYSTEM BLANKS.

return are filed alphabetically, according to the name of the department or firm receiving them, so that it is always possible to tell just what blue prints each department or firm has in its possession.

In addition to the drawing number and blue print record, a *piece number index* and a *general index* are also used. Cards for these are shown in Figs. 6 and 7. It would probably be well to point out the reasons why the cards are arranged as shown, and what, in my mind, appear to be their good points. Taking up first, the drawing number and blue print record card, it will be seen that this also contains the pattern number and the piece number, and thus cross indexes the other two files. There is also a space on this card in which to place the dates of the correction of the drawing. This enables one to tell from the card without looking up the tracing, whether or not the firm receiving a print has the latest one. This drawing number index is of course arranged numerically. The piece number index is also arranged in numerical order and in a similar manner cross indexes each of the other two files. This is also a pattern-record card. Whenever a drawing or piece is no longer used, the proper card is stamped *obsolete* in large red letters. A rubber stamp is used for this purpose.

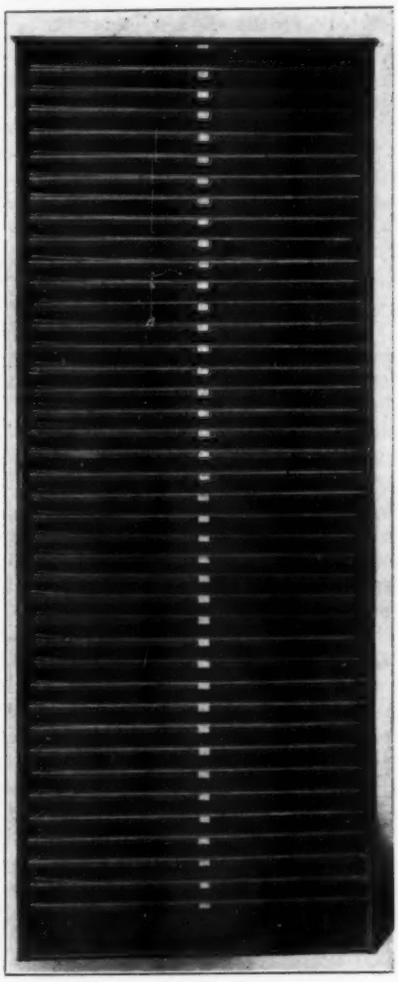


FIG. 8. FILING CABINET.

In arranging the general index, the cars are considered as being divided into several distinct parts. The dividing line of these parts is located by the methods used in assembling these pieces. The cards in these divisions are arranged in alphabetical order—for example: Any connecting rod would be found by looking in this index in the engine division under *R*. This index card, it will be noticed, is particularly valuable when, as often occurs, it is necessary to look up an old drawing for repair work, and it also in its turn cross indexes the other two files. It will be seen that with these three indexes, it will be possible to locate instantly the drawing for any piece, if either the piece number of the piece, its drawing number, or its name is known. These three files are necessary because all shop work is kept track of according to the piece numbers, all drafting room work is charged up to drawing numbers, and most pieces are known throughout the works by their names.

For filing the tracings, large cardboard folios are provided. Each of these holds twenty-five sheets. A view of the filing cabinet provided for this purpose is shown in Fig. 8. A similar cabinet is provided for blue prints, one of the latter being made for every tracing and used instead of the tracings whenever possible. A large cabinet of this sort is also provided for prints showing the state of a tracing before a correction was made, as mentioned above.

Since the general index is necessarily somewhat complex, containing as it does a card for each drawing, whether obsolete or not, it has been found convenient to make lists of the parts used in the several models. The cars are considered as being divided into the same parts as used in the general index. For each of these divisions a list is made for each model of car. These are kept up-to-date and used in the drafting room, main office, shipping room, machine shop and pattern shop. These lists are typewritten upon thin paper with heavy carbon ink, and blue prints are taken from them whenever required. One of the sheets used in these lists is shown in Fig. 9.

All of the tools and fixtures for manufacturing are designed in the drafting room, and a brief description of some of the methods inducing a rapid production of the work will probably be acceptable. These tools are made under the supervision of the chief draftsman and an expert tool designer, who lay out the work, make sketches of what is desired, pass these to the detailers, and they in turn, after completing their work, pass the drawings on to the tracers to be finished.

All patterns for tools are made in our own pattern shop. We have found it convenient, instead of combining the machinist's and patternmaker's figures on one drawing, as is done in the case of our regular details, to make from the pencil drawing of the tool a rough tracing in pencil on thin tracing paper. Two blue prints are made from this. One is filed and the other is sent to the pattern shop. The paper tracing is then destroyed. The drawings are traced in the regular way, but only the machinist's dimensions are placed upon them.

REMARKS	No. REQ.	NAME OF PART	MATERIAL	PART No.	DR. No.	FILE

FIG. 9. LIST OF PARTS.

These tracings are lettered T-1, T-2, T-3, etc., the prefix T denoting that the tracing is for some tool or fixture. The pattern number is obtained by suffixing to the drawing number a letter. For instance, if four castings were necessary to the first tool, the pattern numbers of these castings would be T1A, T1B, T1C, and T1D. This makes it possible for the toolmakers to tell from the pattern numbers of the castings, what tools they are to be used for.

Since the automobile industry is still in its infancy, great strides are being made in this line, and we have found it necessary to keep up-to-date in current topics which concern us. With this end in view, several copies of all prominent automobile and technical magazines are received by us periodically, and the matter in them is carefully gone over and alphabetically indexed in a card file kept for this purpose. In starting this system, requests for catalogs were sent to all prominent manufacturers of parts of automobiles and of completed machines, and also to all the prominent machine-tool builders in the country.

These catalogs, as fast as received, were indexed in two files, in one of which the names of the companies were alphabetically arranged, and in the other, the arrangement was made alphabetically according to the subject matter contained.

While the methods given above no doubt seem somewhat complex from their description, still in operation they are wonderfully simple. One person has complete charge of the indexing and distributing of the piece, pattern and drawing numbers. As a great deal of correspondence is carried on with outside firms in relation to the work in progress, it is necessary to have a stenographer to take care of this correspondence, and the work of indexing is placed in his hands.

The Metric System in Canada.

We have referred to the action of the Canadian government with respect to the metric system as set forth in a recent consular report. More recently Consul R. S. Chilton, Jr., writes from Toronto that a prominent Canadian manufacturer calls his attention to the fact that the lectures given throughout Canada by Professor McLennan, under the auspices of the Canadian government on the subject of the metric system of weights and measures, are for educational purposes only, and are not to be taken as indicating an intention to adopt that policy in the near future. The manufacturer states further:

The Canadian Manufacturers' Association has requested the Canadian government to withdraw the McLennan lectures, and asks the government to take no action on weights and measures until such is done by Great Britain and the United States. They have also recommended that the chambers of commerce of the Empire, at their meeting in London this year, ask for a royal commission to investigate weights and measures, and to report a system which will be acceptable.

Henry Ford, the Detroit automobile manufacturer, is evidently determined to be "in it" when the denatured alcohol bill is passed. He has for some time had his experimental force conducting exhaustive experiments to determine the best type of carbureter or mixing valve for vaporizing alcohol for internal combustion motors, with, it is stated, very satisfactory results. They have been able to get 60 horse-power in several tests on a six-cylinder motor, which showed only 52 horse-power when using gasolene. Instead of using a Prony brake, the power is determined electrically, a dynamo being directly connected to the shaft of the engine.

A 4000-h.p. gas engine of the double-cylinder tandem duplex type, to be operated by blast-furnace gas is being installed by the Westinghouse Machine Company, in the Edgar Thompson Steel Works at Braddock, Penn.

Planetary Gears.

BY ANDREW STROM.

A planetary system of gears, as understood in this article, is an arrangement whereby one or more gears (usually two or three) mounted on studs fastened to a frame or yoke are made to revolve around a central gear, and thus impart rotary motion to said frame or yoke. Such a system of gearing is not new; it is at least as old as the steam-engine, and nobody knows how much older. Watt, the father of the steam-engine, used planetary gears in lieu of a crank to convert the reciprocating motion of a piston into rotary motion, yet it would probably be hard to find in books on gearing as well as in engineers' and mechanics' pocket books any formulas for this system of gearing or any references to their peculiarities. They are not infrequently used, but outside of those who have actually used them, their action and peculiarities seem to be little understood among draftsmen and machinists. This ought not to be so, for planetary gears possess some advantages which ought to make them more popular and more used, were they but better known and appreciated.

There was a time when gears were costly and methods of cutting them were, if not crude, yet not very perfect and also somewhat slow. This is true even of the present-day milling machines, and it, of course, made designers reluctant to use two or more gears where the same reduction could be had with one, even though that one had to be made a little stronger and put to one side, but, since the advent of the automatic gear-cutter and the gear shaper, the cost of gears, well cut and smoothly running, has been reduced to a minimum. Today gears finished from drop forged blanks or cut from bar stock are cheap, and they are good gears too, capable of being run at a pretty high speed without a great loss of initial energy. All this, however, has come about slowly, and we are apt to overlook it; although we know it is true we do not always realize the importance of it. That it is realized in some quarters is shown by the number of machine tools in which a gear-box has taken the place of the stepped cone; a notable instance is the new Jones & Lamson machine recently illustrated in the columns of this paper. Having learned years ago that internal gears are expensive and not very satisfactory, it is not so easy to realize that today internal gears are just as cheap and just as well cut as other spur gears. This is is probably the reason why planetary gears have not received as much consideration as they are worthy of; however we will, in this article, see what their merits are.

Referring first to Fig. 1, which is not a planetary gear, but only an arrangement whereby a central gear or pinion drives an internal gear through the medium of two or more idlers rotating on fixed studs located half way between the pitch lines of the driver and the driven gear. The ratio between the gear is, of course, 2 to 1, two revolutions of the central gear to one of the internal gear. This arrangement has the advantage over ordinary spur-gearing that by introducing two or more idlers the strain is distributed on several teeth, which in some cases would allow of a finer pitch being used. The driver and the driven gear work in the same center line and yet the arrangement is perfectly symmetrical and easily, yes quite naturally enclosed, the internal gear forming its own gear-box. Many a machine looks clumsy and unsymmetrical because a gear and pinion are placed to one side where, if the gears had been arranged as in Fig. 1, the appearance of the machine would have been greatly improved, and, by distributing the strain on the gear teeth, the life of the machine perhaps prolonged. Another very important point in favor of this arrangement is its beneficent influence on the journals, there being no side strain due to the gears as in the case of only one intermediate idler.

Now referring to the planetary arrangement of gears shown in Fig. 2, it is at once apparent that all the advantages enumerated above apply equally to this arrangement, and besides the gear box, of which the internal gear is a part, is now stationary. It is a part of the frame of the machine or box screwed or bolted to the frame, but symmetrical, without any unsightly warts or projections, and it forms a good oil chamber and occupies little space. Whereas, in Fig. 1 the shafts, while in the same center line, run in opposite directions, with this latter arrangement, the planetary gears, the two shafts run in the same direction. Also, the speed ratio is not the same. With the same gears as in Fig. 1, the ratio has changed to 3 to 1 instead of 2 to 1, the driving-gear or pinion making three revolutions to one revolution of the frame or yoke on which the idlers are mounted. I dare say a lathe with this arrangement inside the cone would look odd to us, but with a suitable clutch, to throw the center gear out of mesh with the idlers and into direct engagement with the idler frame, it would do away with the usual back gear, and keep the gears enclosed and running in a bath of oil.

Fig. 3 shows a planetary gear in which the central gear is stationary, and the internal gear acts as a driver. This is a little used arrangement and is shown here more for the purpose of illustrating the flexibility of planetary gears than to try to emphasize its importance. Here again the ratio has been altered although the same gears are used. It looks at first glance as if the result would be an increase in speed, but it is not. The ratio between driver and driven is 3 to 2, three revolutions of the internal gear making

two revolutions of the frame on which the idlers are mounted.

Here then are three gears, it being, of course, understood that the extra idlers are not essential to the speed ratio, but are introduced for the purpose of distributing strain and balancing the machine, giving three different speed ratios (all decreasing) in practically the same space, and with very little change in design and no change in exterior appearance; the ratios in the figures being 2 to 1, 3 to 1 and 1½ to 1. The ratio in Fig. 1 is well understood and will not here be spoken of, but the formulas for obtaining the speed ratios in Figs. 2 and 3 are very little known. I venture to assert that not one machinist in fifty knows how to figure it out. Here is the formula I use, and I believe it is the simplest one to be found:

Add together the number of teeth in the central gear and in the internal gear, then divide by the number of teeth in the driving gear. Thus, in Fig. 2, we get $\frac{48+24}{24}=3$, and in Fig. 3 we get $\frac{48+24}{48}=1\frac{1}{2}$. The result, of course, is the number of revolutions of the driving gear to each revolution of the idler frame or yoke.

It will now be apparent that a ratio of 2 to 1 cannot be obtained in planetary gears, as the following example will show:

$2=\frac{x+48}{48}$, x (representing the center gear in Fig. 3) $=48$. Of course, the center gear cannot have the same number of teeth as the internal gear, and leave room for idlers.

Any other ratio than 2 to 1 may be obtained, although as we approach this ratio the planetary gear arrangement becomes impractical, owing to the fact that, as 12 teeth is practically the smallest number we can use in the involute system, the difference between the two principal gears must be at least 24 teeth, allowing 12 teeth for the idler, and, therefore, the gears get pretty large as we approach the 2 to 1 ratio. Planetary gears are, however, better suited for greater speed reduction, and with a small pinion in the center acting as the driver, say 12 teeth cut on the end of a motor shaft, it is surprising what a great speed reduction may be obtained in a comparatively small symmetrical space.

Fig. 4 shows a case where an armature speed of 3000 revolutions per minute has been reduced in one step to a spindle speed of 250 revolutions per minute, the ratio in this case being 12 to 1.

We can, however, do better than that by compounding these gears as shown in Fig. 5. This arrangement I have never seen used except where I have used it myself with considerable success. However, I would be very surprised to find

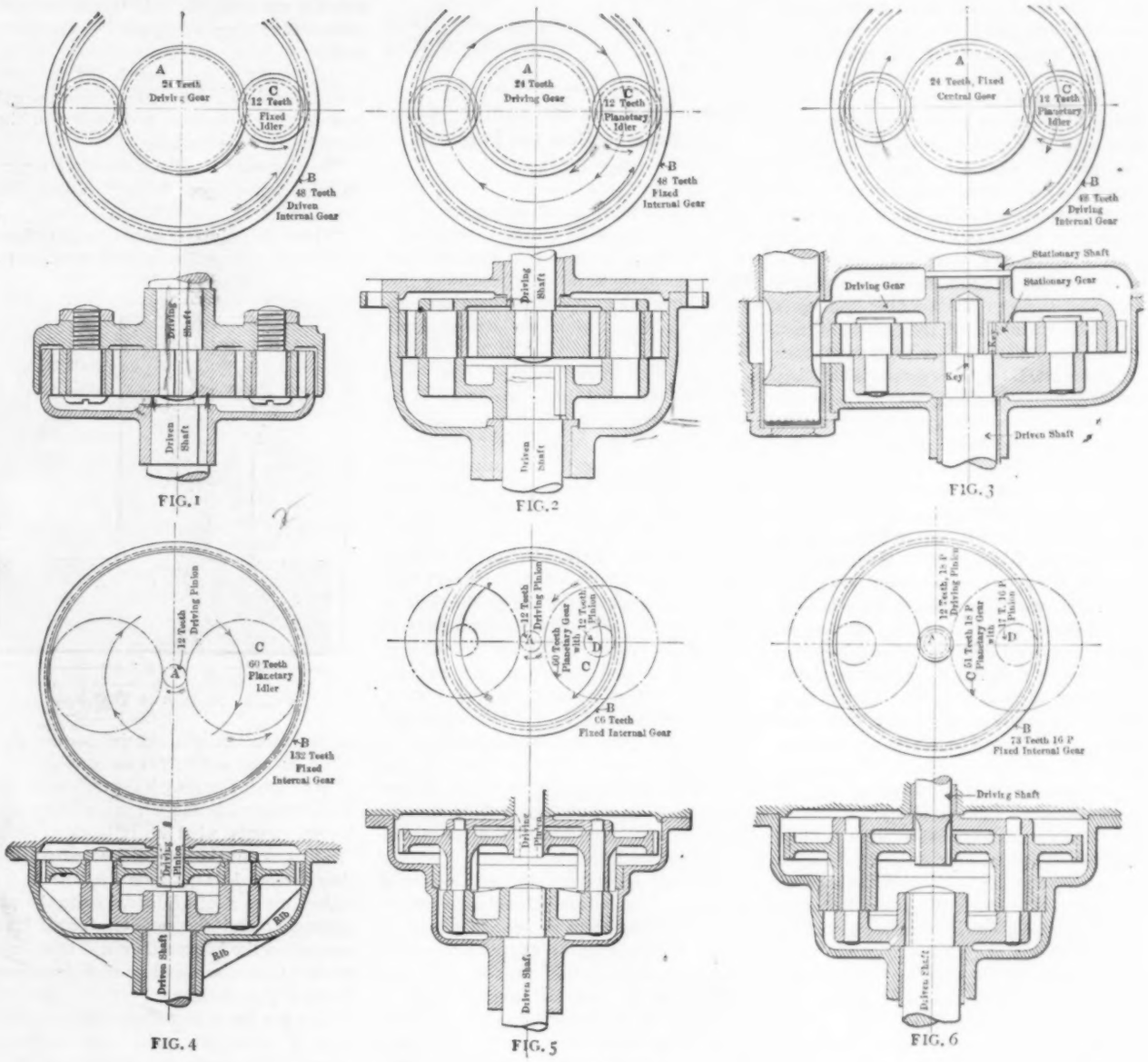


FIG. 1 FIG. 2 FIG. 3

FIG. 4 FIG. 5 FIG. 6

PLANETARY GEARS.

that it has never been used before, although not more so than I was at seeing how little known the planetary gears are even among draftsmen and engineers.

In the arrangement shown in Fig. 5, the ratio is 28½ to 1, although the gears are not any larger (the internal gear being really only half as large) than in Fig. 4, and the space occupied being practically the same. Thus from an armature speed of 3000 revolutions per minute we obtain a spindle speed of 150 revolutions per minute.

In designing these gears I have generally used a coarser pitch for the internal gear and idler pinions than for the central pinion and idler gears. This, of course, is easily done, but the center distance between the idlers must then be a number or fraction divisible by both the pitches which it is desired to use. The reason for this is apparent, as the distance plus the diameter of the idler pinion is the pitch diameter of the internal gear. Here two diametral pitches such as 16 and 12 will work together where the center distance between the idlers is expressed in quarter inches, while 16 and 14 pitch will require half inches, and 7 and 6 pitch nothing less than even inches.

Another point to keep in mind is to make the internal gear and the driving pinion with a number of teeth divisible by the number of idlers which it is proposed to use. This, in the compound gear, Fig. 5, is not strictly necessary, but advisable nevertheless, as otherwise the idlers must either be placed in an unbalanced position or be cut in different ways, that is, differing from each other. For instance, in Fig. 6 is shown a case where the center pinion has 12 teeth and the internal gear 73 teeth, two idlers are used, placed in a line drawn through the center of the central pinion. These idlers have to be cut so that, where one has teeth on gear and pinion in line, the other has a space on the gear in line with each tooth on the pinion. These gears are perfectly correct and work well, but it is somewhat inconvenient to cut one each way. The number of teeth in the idler gear should be a multiple of the number of teeth in the idler pinion, then when the idlers and the internal gears are assembled the center pinion will drop into place; but if the internal gear is put in last, the idlers may have to be moved one or two teeth, depending on the ratio of teeth on the idler gear and pinion, in order to get the internal gear in the mesh.

All these things seem to be restrictions, and so they are, but when known, it is very easy to guard against errors, and the restrictions do not in the least impair the usefulness or the flexibility of the planetary system of gearing. In figuring the ratio of the compound gears, of course, the idlers must also be considered. Thus in Fig. 5 the formula is:

$$\frac{\text{No. of teeth in internal gear} \times \text{No. of teeth in idler gear} \;\text{plus}\; \text{No. of teeth in central pinion} \times \text{No of teeth in idler pinion}}{\text{No. of teeth in central pinion} \times \text{No. of teeth in idler pinion}}$$

or in Fig. 5

$$\frac{(66 \times 60) + (12 \times 12}{12 \times 12} = \frac{3960 + 144}{144} = 28\tfrac{1}{2}.$$

and in Fig. 6

$$\frac{(73 \times 51) + (12 \times 17)}{12 \times 17} = \frac{3723 + 204}{204} = 19\tfrac{1}{4}.$$

The ratio in Fig. 6 being 19¼ revolutions of central pinion to one revolution of idler frame.

Echoes From the Oil Country—Cast-Iron Beams—How the Formulas Got Worked.

A good rule for any designer who is to have his work tested by the general public is to keep in mind the dumbest man who is likely to handle the machines, for the failures count for more than the successes, usually, and in the wrong direction.

There are some practical men who firmly believe that there are some very learned writers on mechanical subjects who never heard of such a rule or one anywhere near like it. The necessity for the rule does not seem to be of the most recent date, as I find in the preface of Trautwine's "Engineer's Pocket-Book," edition of 1881, in speaking of the work of some of the master minds, he says: "Although their books are the productions of master minds, and exhibit a profundity of knowledge beyond the reach of ordinary men, yet their language is also so profound that few engineers can read them. The writer himself, having long since forgotten the little higher mathematics he once knew, cannot. To him they are but little more than striking instances of how completely the most simple facts may be buried out of sight under heaps of mathematical rubbish."

It would seem that in the working out of formulas the effort should always be toward getting them as near "fool-proof," to use a good old shop expression, as possible, especially should they be so stated when used in a text or reference book.

It may be of interest to some to know how some of them are interpreted, and the following is given as an illustration.

It all started in a discussion as to where a rib should be located.

If it had not been that several of the men were taking courses in a correspondence school it might not have started, for the question as to the best place to put the rib might not have been looked at in the same way that it was when viewed through the light of pure science.

When a piece breaks in regular service the fellow who does not know what strains it is subjected to, and would not know enough to figure their value if he did, is apt to think that it is not strong enough, and his next thought is apt to be that he should have it made stronger, that is if he is responsible for it.

This piece that broke was in effect a rectangular beam set with the deep side vertical. It was several times as deep as it was broad and the old man thought that a rib put on one edge would help it. It would perhaps be more accurate to say that he thought of two ribs, for it would make a T-section when finished. This beam in use would be held fast at one end and the stress applied upward at the other end.

"Just make a little sketch for the patternmaker showing a section," said the old man to the draftsman, and gave him the sizes he thought suitable.

"Do you want these pieces on the top or on the bottom of beam?" asked the draftsman.

"There is only one place to put them and that is where they will do some good.

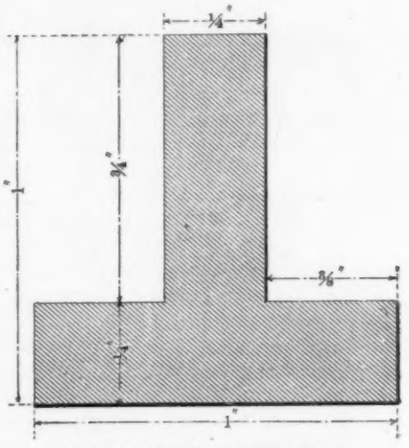


FIG. 1. SECTION OF TEST BAR.

If they are not put on the bottom they might as well not be put on at all."

"As far as strength goes," said the draftsman, with the air of a man who knows exactly what he is talking about, "it does not make any difference whether they are on the top or on the bottom, but it does make a lot of difference to the patternmaker and the molder, for if they are put on the bottom they will have to be made in core, while they will draw very nicely if put on the top."

"Do you mean to tell me that you think that it will not make any difference whether the pieces are on the top or on the bottom, as far as the strength is concerned?"

"I don't pretend to know anything about it, but it is easy to show you what some people who do pretend to know something say about it," and suiting the action to the word the table was soon adorned with handbooks bearing among others the names of Kent, Jones and Laughlin, Cambria, and Suplee, and the air was full of moment of inertia, modulus of section, uttermost fiber, radius of gyration, transverse stress, moment of resistance, moment of the force, neutral axis, etc., along with letters major and letters minor,

with and without subs and primes, and prefixes and suffixes, and signs and symbols, and formulas and demonstrations until it was not fit for anyone but a college-bred man to breathe. To keep it from being too easy (come easy, go easy, you know; the harder you have to work for a thing the more you prize it after you get it, so they say), the different authorities did not use the same letter, figure or what not to designate the same thing, and besides one of them might have the same symbol stand for several things, and then to make up for it have several ways of representing the same thing. This kept the humble investigator from going to sleep and made him respect the wonderful wisdom so ably concealed.

These men really wanted to know the facts in the case and set to work earnestly to dig out such information as they thought applicable to the job they were on, but with all their efforts did not feel very sure of their ground. Others were drawn into the discussion but without getting anything definitely decided.

"It would seem as though all of these fellows are trying to tell the same thing but that they do it in different ways. Is not that right?" asked one after they had been going over the matter for some time, referring to the books.

"It certainly looks that way," responded another.

"But," objected the first one, "some of these companies who put out handbooks only work in wrought iron and steel, or perhaps today only in steel, and rules that might be very true with their product might not be right with cast iron."

"What difference does it make whether the rule is applied to steel or to cast iron? A beam is a beam, is it not?"

"A beam is a beam, all right enough, no matter what it is made of, but there is a lot of difference in the ratios of the tensile and the compressive strengths of the different materials. With wrought iron they are given as being the same, while the difference for cast iron is as two is to nine. It seems queer that the same rule would work in both cases."

"But see here, don't you see that you use the transverse strength for beams," broke in another; "the tensile and compressive strengths don't have anything to do with it."

"I'd like to know if transverse strength is anything but a combination of tensile and compressive strength. Is it not tensile strength on one edge of the beam and compression strength on the other edge of it?"

Number of bar	1	2	3	4	5	6
Way Tested	T	T	T	⊥	⊥	⊥
Broke at	1025 lbs.	1195 lbs.	1075 lbs.	1975 lbs.	1980 lbs.	1975 lbs.
Deflection Inches	0.11	0.12	0.12	0.18	0.19	0.18

TABLE I. RESULTS OF TRANSVERSE TESTS.

"If that is true, why can't you figure out the strength of a beam with them?"

"Maybe I could if I was smart enough to find the position of the neutral axis."

"If that is all you want I can tell you where to find it," said the book-worm. "Of course you won't think that I know anything practical so here is the authority." He reached for a book and read: "'It is shown in works on mechanics that *the neutral axis always passes through the center of gravity of the cross section of the beam.*' You see they have it put down in italics so that it will be plain."

The "practical man" did not know how to get around the plain statement of the book but then he was a natural doubter anyhow. As he turned the leaves he came to a place where a number of sections were shown with their moments of inertia figured out, and began to study the T-section. "If what you say is true, and what this seems to show is true, a **T**-beam will have the same strength whether it is set with the head up like this **T**, or down like this **⊥**. That may be true of some materials but I am willing to bet two cents against a pants button that it isn't true of cast iron. Either you fellows can't make out properly the mystifying hieroglyphics of the books or else the books don't know what they are talking about. To make the matter simpler, suppose it was a beam laid on two supports with the weight applied in the center; which side up would be best to place it?"

"I would put it with the head down and would expect it to be about twice as strong as if I put it the other way. What do the rest of you think?"

A canvass of the crowd showed that some were not willing to do any thinking. It was presumptuous to doubt the "authorities." Some of the practical men who did not go into the books much had opinions and they were about evenly divided as to which way such a beam would be strongest.

The foundry had a small testing machine and a pattern was made for a T-bar. It was 1 inch across the head and 1 inch high. Both head and upright were one-quarter of an inch thick, and it was about 13 inches long. That would do for the machine which was 12 inches between supports. Some bars were cast from this pattern and tested. Six bars were cast, two in a flask. They were made of different kinds of iron, the idea being to get both hard, soft and medium bars.

With the head up one bar broke at 1225 pounds, one at 1000, and one broke before it got to 1000.

With the head down one bar broke at 2000 pounds, one at 1875 and one at 2250.

In trying to be scientific a rig for making drop tests had been made. It had been made so that the bars could be tested, after they had been broken, on the other machine. The supports were about 5 inches apart and the drop weighed 12.5 pounds. With the head up not a bar stood one drop of 7 inches. With one bar the drop was reduced to 5 inches and the bar broke at the second drop. With the head down one piece stood 137 drops, breaking with the 138th. Fifty-seven drops was the least that any of them stood in this position. The other piece of the one that broke at the second 5-inch drop stood 78 five-inch drops and then broke at the fourth 7-inch one. In the excitement of this test the pieces got mixed and it was not certain that one-half of each bar was tested in each position, and to verify results some more bars were made and tested. Six bars were made as nearly as possible alike and cast from the same ladle of iron. The instructions to the man who made them did not tell him what iron to use, and he poured them with cylinder iron which was harder than would have been put into castings a quarter of an inch thick. Before beginning these tests each bar was numbered and marked in such a way as to prevent their getting mixed.

The following tables will show the results of the tests. In the drop tests that were taken with the head up none of the bars stood more than one drop, and they seemed to break so easily with one drop that it seems as if the table does not show the real difference between them as tested that way and as tested with the other side up. There was nothing in the size or the appearance of the number 3 bar to show why one part of it should stand 24 drops as it did.

Number of bar	1	2	3	4	5	6
Drops with head up, T	1 7 in. Drop	1 6 in. Drop	1 6 in. Drop	1 6 in. Drop	1 6 in. Drop	1 5 in. Drop
Drops with head down ⊥	3 7 in. Drop	3 7 in. Drop	24 7 in. Drop	4 7 in. Drop	2 7 in. Drop	4 7 in. Drop

TABLE II. RESULTS OF DROP TESTS.

We are all satisfied that it does make a big difference which side up such a section lies, but do not know how to figure the strength of the section in the different positions.

The pieces were then tested with the drop, one piece of each bar being tested with the head up and the other with the head down, with the results shown in Table II.

It may be that the language of the major master minds is so profound that the minor master minds, who pass it down so that it is more nearly within the reach of those who have to take it on faith, do not rightly interpret it. For instance, while one authority says that the neutral axis always passes through the center of gravity of the beam, and in reply to a letter they plainly state this to be true "regardless of the shape or of the material," yet one of the most recent ones (Suplee) says: "In such materials as steel and wrought iron the resistance to compression and tension may be taken as equal, and this neutral axis, as it is called, then coincides with the center of gravity."

Trautwine gives some tests showing some of the differences just as shown by these tests and his state of mind may be judged by his statement, "Cast-iron beams should always be tested," and "Much uncertainty exists in the whole matter."

It is certainly safer for a man to know that he doesn't, and perhaps cannot, know anything about a subject such as this than for him to think that he is figuring it out safely when his conclusions are entirely erroneous. W. OSBORNE.

One of the ways in which the automobile has benefited the art and practice of machine construction generally is in bringing out what is known as the Hele-Shaw clutch, which was invented a few years ago by Professor Hele-Shaw, of Liverpool University, in connection with automobile work and which has proven to have a much wider application. It will be remembered that we showed sections of this clutch some time ago, and that it consists of thin disks of sheet metal, one set of these being attached and rotating with the shaft, while another alternate set is attached to and is held stationary by the casing, there being a V-shaped annular corrugation in each disk. Upon the surfaces of these corrugations the friction and wear take place, and to increase the capacity of the clutch it is necessary only to add more plates, and a very slight end pressure produces immense driving power. These clutches have been applied to a great variety of purposes, and among others they are being used on the Thames in motor boats for giving a reverse motion to the screw. This has proven to be a very advantageous arrangement, and a company has been formed for the regular manufacture of these clutches in Liverpool.

Collapsing Pressures of Bessemer Steel Lap-Welded Tubes Three to Ten Inches in Diameter—I.*

BY REID T. STEWART.

This research was undertaken for the purpose of supplying an urgent demand for reliable information on the behavior of modern wrought tubes when subjected to fluid collapsing pressure. Every means known to engineering science that could aid in the accomplishment of this undertaking has been used, and every possible effort made to get at the truth and have the research yield trustworthy data. It was planned and executed under the immediate direction of the author, at the McKeesport works of the National Tube Company, and has occupied for its completion, during a period of four years, the time of from one to six men.

Series One—This series of tests was made on tubes that were 8¾ inches outside diameter, for all the different commercial thicknesses of wall, and in lengths of 2½, 5, 10, 15 and 20 feet between transverse joints tending to hold the tube to a circular form. The chief purpose of this series of tests was to furnish data for determining which of the existing formulas, if any, were applicable to modern lap-welded steel tubes, especially when used in comparatively long lengths, such as well casing, boiler tubes and long plain flues.

Series Two—This series of tests was made on single lengths of 20 feet between end connection, tending to hold the tube to a circular form. Seven sizes, from 3 to 10 inches outside diameter, and in all the commercial thicknesses obtainable, have been tested to date. The chief purpose of these tests was to obtain, for commercial tubes, the manner in which the collapsing pressure of a tube is related to both the diameter and thickness of wall.

Inapplicability of Previously Published Formulas—Preparatory to entering upon the present research all existing published formulas that could be found were collected, and, after the completion of series one, were tested as to their applicability to modern steel tubes. Among the formulas thus tested were two each by Fairbairn, Unwin, Wehage and Clark, and one each by Nystrom, Grashof, Love, Belpaire, and the Board of Trade (British), all of which, with possibly two exceptions, appear to be based upon Fairbairn's classical experiments made more than a half century ago, upon tubes wholly unlike the modern product. Without exception, all of these formulas, when thus tested, proved to be inapplicable to the wide range of conditions found in modern practice. As an illustration of this, the very first tube tested in connection with this research failed under a pressure that exceeded by about 300 per cent. that calculated by means of Fairbairn's formula.

The planning and execution of this research was rendered especially difficult because of the lack of any reliable data bearing upon the behavior of modern wrought tubes when subjected to a fluid collapsing pressure. Fairbairn's classical experiments, made about a half century ago, were naturally of such a character as not to furnish any suitable data for the planning of a similar but much more elaborate research on modern tubes. Aside from the numerous formulas, some ten or twelve in number, based practically upon Fairbairn's experiments, and therefore not to be seriously considered in this connection, the only available data consisted, so far as could be discovered, of a few isolated experiments on flues and several records of the condition under which tubes and flues have failed in service, together with a table of computed collapsing pressures published in a well-known handbook, whose origin could not be traced.

PRELIMINARY CONSIDERATIONS.

While planning this research it was assumed that the resistance offered by a tube to an external fluid pressure would depend upon the following five things, namely:

1. The diameter of the tube.
2. The length of tube between transverse joints or end connections tending to hold it to a circular form.
3. The thickness of the wall.
4. The deviation of the tube from perfect roundness.
5. The physical properties of the material of which the tube is made.

Of these five things that may vary it was thought that, for the preliminary experiments, at least, Nos. 4 and 5 would be practically constant; No. 4, because the tubes, being all made by the same process, would probably run fairly uniform as to deviation from roundness, and No. 5, because the material in this case being bessemer tube steel, is known to run fairly uniform in its physical properties. The physical tests would, of course, serve as a check upon this latter.

The only variation, then, to be expected in Nos. 4 and 5 would be that due to the inability of the manufacturer to turn out a uniform product. It is recognized here that the physical properties of rolled steel depend in some measure, other things being equal, upon the thickness of the plate; or, in this case, upon the thickness of the wall of the tube. It is clear that any variation would be a function of the thickness, and would consequently be taken care of in an empirical formula by the quantity representing the thickness.

All the published formulas bearing upon the subject indicated that the diameter and thickness of wall have each an important determining influence on the collapsing pressure of a tube, and since there were the best of theoretical reasons for

*Abstract of a paper read at the Chattanooga meeting of the American Society of Mechanical Engineers.

believing this to be the case, it was of course decided to plan the research to discover, if possible, the precise nature of this influence over a wide commercial range.

The influence of length of tube between transverse joints, or end connections tending to hold it to a circular form, upon the collapsing pressure appeared, in the light of available data, to be the most uncertain of all the variables entering the problem. It was therefore decided, first of all, to determine the precise nature of this influence.

In order to do this the following apparatus was used, the greater part of which was especially constructed for this research:

HYDRAULIC TEST APPARATUS.

The production of a suitable apparatus in which to subject the tubes to an external fluid pressure, and at the same time handle with expedition the large number of tests contemplated, was a somewhat difficult problem to solve. After much consideration of the matter the scheme illustrated in Fig. 1 was adopted.

It will be seen by reference to this illustration that the scheme provides for:

1. A test cylinder with one head removable for the reception of the tube to be tested, this cylinder being provided with means for creating an hydraulic pressure within, thus subjecting the tube under test to a fluid-collapsing pressure.

2. A low-pressure water supply of large volume to rapidly fill the space within the test cylinder not occupied by the tube under test.

3. A variable high-pressure water supply furnished by an hydraulic pressure pump, the purpose of which was to create a fluid pressure within the test cylinder, the tube under test by this means being subjected to a gradually increasing fluid-collapsing pressure.

4. A set of pressure gages, having a large range in capacity connected so that they could be used either singly for indicating the fluid pressure within the test cylinder or in combination for comparison.

5. A vent pipe leading from the interior of the tube under test through the head of the test cylinder to the atmosphere in order to maintain constantly an atmospheric pressure within the tube being tested.

6. An air vent connecting with the highest point of the interior of the test cylinder, in order to thoroughly free from air the interior of the test cylinder while being filled with water, after the insertion of a tube to be tested.

In addition to the above, while carrying out this scheme, devices were in use for manipulating the removable head, and for handling the tubes while being entered and withdrawn, but in order not to encumber the paper with unessential details no mention of these will be made.

Eight-Inch Test Cylinder—This smaller cylinder was constructed for the purpose of testing the 3- and 4-inch tubes, and all of these sizes were tested in it with the exception of Nos. 462 and 464-469. This test cylinder was made up from a single 20-foot length of 8-inch double extra strong pipe, 8⅝ inches outside diameter, and ⅞-inch wall.

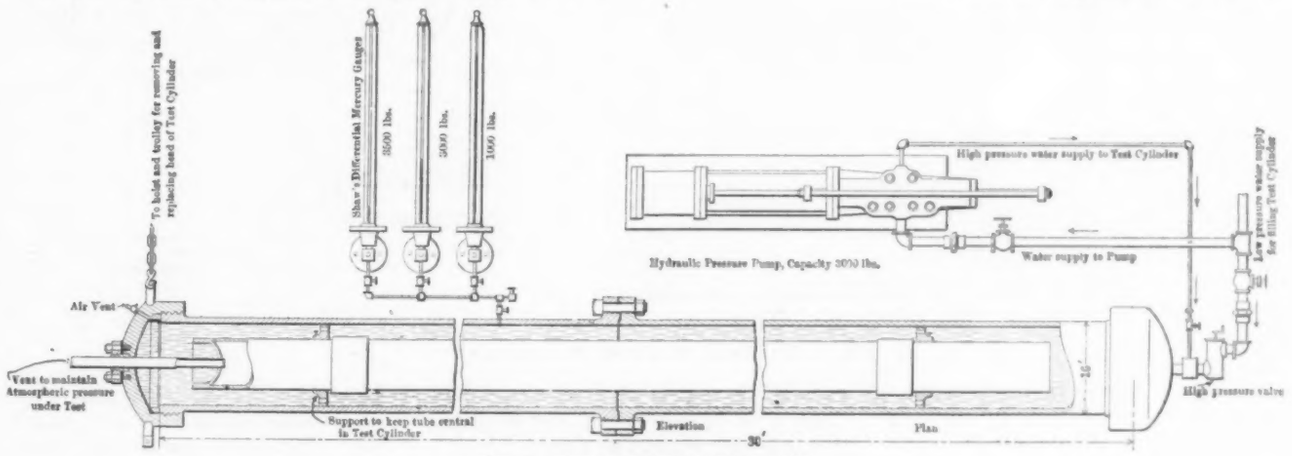

To hoist end trolley for removing and replacing head of Test Cylinder
Shaw's Differential Mercury Gauges
3500 lbs.
5000 lbs.
1000 lbs.
High pressure water supply to Test Cylinder
Hydraulic Pressure Pump, Capacity 5000 lbs.
Water supply to Pump
Low pressure water supply for filling Test Cylinder
Air Vent
Vent to maintain Atmospheric pressure under Test
Support to keep tube central in Test Cylinder
Elevation
Plan
High pressure valve
30'

FIG. 1. HYDRAULIC TEST APPARATUS.

The details of one end of this cylinder, with tube under test in place, are shown in Fig. 2, the other end being an exact duplicate of the one shown. It will be observed that this apparatus is arranged so as to permit of testing a plain end tube, with the ends open to the atmosphere, and the interior of the tube exposed to view while under test. In this way the tube while under the test is entirely relieved of any longitudinal stress due to the fluid pressure surrounding it. The sectional view shows clearly the construction of the cylinder. It will be observed that the tube is held in place within the test cylinder by steel centering rings, one at each end, while the cup leather packing rings are being slipped in place over the ends of the tube to be tested. This leather packing ring, at each end of the test cylinder, is backed by a cast-iron ring that fills the space, as shown between the inner surface of the end of the test cylinder and the outer surface of the end of the tube under test. This latter ring is held in place by means of a steel sleeve engaging its outer surface by means of an internal flange, and which is attached to the end of the test cylinder by means of the trapezoidal threads shown.

A plug was inserted, as shown, near each end of the experimental tubes for the purpose of preventing the centering ring and packing from being damaged, and the attendant difficulty of removal of tube that might result from the tube collapsing in the end connections. Since a commercial tube is more apt to collapse at or near one end than near the middle of its length, this simple expedient made it possible to conduct the experiments without the frequent delays that would otherwise have resulted from the jamming of the tube in the end connections.

This small test cylinder was placed over and was supported by the larger one. It was connected to the same set of pressure gages, and was operated, in every essential respect precisely as was the larger apparatus.

AUTOGRAPHIC CALIPERING APPARATUS.

Since it was anticipated that the out-of-roundness of the tube under test would exert a controlling influence on its behavior, it was thought best to devise a piece of apparatus that would indicate this deviation from perfect roundness with accuracy and expedition. A number of schemes for accomplishing this result were worked out. Of these two were constructed and used.

COLLAPSING TESTS, SERIES ONE, SHOWING THE INFLUENCE OF LENGTH OF TUBE ON THE COLLAPSING PRESSURE.

Since the influence of the length of tube, between transverse joints or end connections tending to hold it to a circular form, upon the collapsing pressure appeared to be the most uncertain element entering the problem, it was thought best, first of all, to determine the precise nature of this influence. Accordingly, it was decided to make a series of tests on a single diameter of tube for all the commercial thicknesses of wall obtainable, in five different lengths of from 2½ to 20 feet.

Selection of Tubes for Testing—The tubes used in making this series of tests, as well as the other series contained in this paper, were obtained from the National Department of the National Tube Company, McKeesport, Pa., on order issued by the Job Work Shop, in the usual commercial way. Those who filled these orders had no means of knowing for what purpose the tubes were to be used, and presumably, therefore, the tubes thus obtained for purposes of testing represent fair samples of the regular commercial product of the mills.

Every tube thus obtained, without exception, was tested, the complete results of all tests being recorded in the Log, a summary of which appears in this paper. Since every tube delivered was tested the results obtained may be accepted as indicating the strength to resist fluid collapsing pressure of this company's bessemer steel lap-welded tubes, the tubes being taken just as they are found in stock.

Diameter of Tube Tested—For series one it was decided to use 8¼-inch well casing, which has a nominal outside diameter of 8⅝ inches. This size was adopted because, taking all things into consideration, is seemed to afford the greatest opportunities for getting at the results desired.

Thickness of wall—There were five nominal thicknesses of wall tested in series one, namely: 0.180, 0.229, 0.271, and 0.322-inch, having nominal weights of respectively 16.07, 20.10, 24.38, 25.00 and 28.18 pounds per foot length for the outside diameter of 8⅝ inches chosen for this series. The average thickness of wall of the tubes of this series was calculated from the plain-end weight, length, and average outside diameter. In this way a more exact value could be arrived at for the average thickness than by any other practical means.

The greatest and least thickness of wall at the place of collapse were obtained from the tube, after collapse, by cutting it across at the point of its length where the distortion appeared to be greatest, after which the greatest and least thickness were measured by means of a micrometer caliper.

Lengths of Tubes—The tubes for series one were ordered in five lengths for each of the five thicknesses tested. These lengths were 20, 15, 10, 5, and 2½ feet, including the threaded ends, for this series. For the tubes of all the other series contained in this report the length ordered in each case was 20 feet, for both plain and threaded ends. Groups Nos. 26 to 30 inclusive, and 77 to 79 inclusive, were supplied in random lengths, presumably, because the stock did not contain tubes of sufficient length, at that date, to fill the order in 20-ft. lengths for tubes of these particular weights. All the other tubes were supplied in substantially the lengths as ordered.

The actual lengths of the tubes tested, to the nearest thousandth of a foot, as measured by means of a steel tape, include both threaded ends, the coupling that is usually shipped as a part of every threaded tube, and which is ordinarily measured up as a part of its length, not being included in these measurements. The measurements on the tubes of the other series that have threaded ends were made in the same manner.

The unsupported lengths of the tubes were arrived at by subtracting the lengths of the portions of the threaded ends that lay inside the couplings from the corresponding actual lengths, giving the actual length of tube exposed to a fluid collapsing pressure, and which, at the same time, received no direct supporting action from any outside source tending to hold it to a circular form. These were the lengths used in deducing the general conclusions from the individual experiments.

It will be observed that the experimental tubes, with but few exceptions, were composed of bessemer steel. In series one three of the tubes tested proved to be wrought iron and also three open-hearth steel, all the others of this series being bessemer steel. In series two one group of five tubes proved to be wrought iron.

The bessemer steel constituting the tubes had the following average physical properties:

Tensile strength, pounds per sq. inch	58,000
Yield point	37,000
Elongation in 8 inches, per cent	22
Reduction of area, per cent	57

And the following average chemical analysis:

Sulphur, per cent	.069
Phosphorus, per cent	.106
Manganese, per cent	.35
Carbon, per cent	.074

DEDUCTION OF LAW SHOWING THE RELATION OF COLLAPSING PRESSURE TO THE LENGTH OF TUBE.

Collapsing Pressure Corrected to Nominal Thickness—The observed collapsing pressures, of course, in each case correspond to the actual thickness of the tube. Since the actual thicknesses of different commercial tubes of the same nominal thickness of wall vary somewhat in practice, it becomes necessary, in order to get strictly comparable results, to obtain from the observed collapsing pressure of each experimental tube, whose thickness of wall did not equal exactly the nominal thickness, a collapsing pressure that would correspond to this nominal thickness. That is to say, the observed collapsing pressures corresponding to the respective thicknesses of wall tested were corrected, so that each would represent what the collapsing pressure would have been had the tube had the exact nominal thickness.

This correction was made graphically by first plotting, to a vertical scale representing collapsing pressure and a horizontal scale representing thickness of wall, the results of the tests for all the different thicknesses of wall for each of the five lengths of tube; second, drawing the mean line representing average results; and, third, drawing a line parallel to this mean line through the plotted value for each tube intersecting the ordinate corresponding to the thickness of that tube.

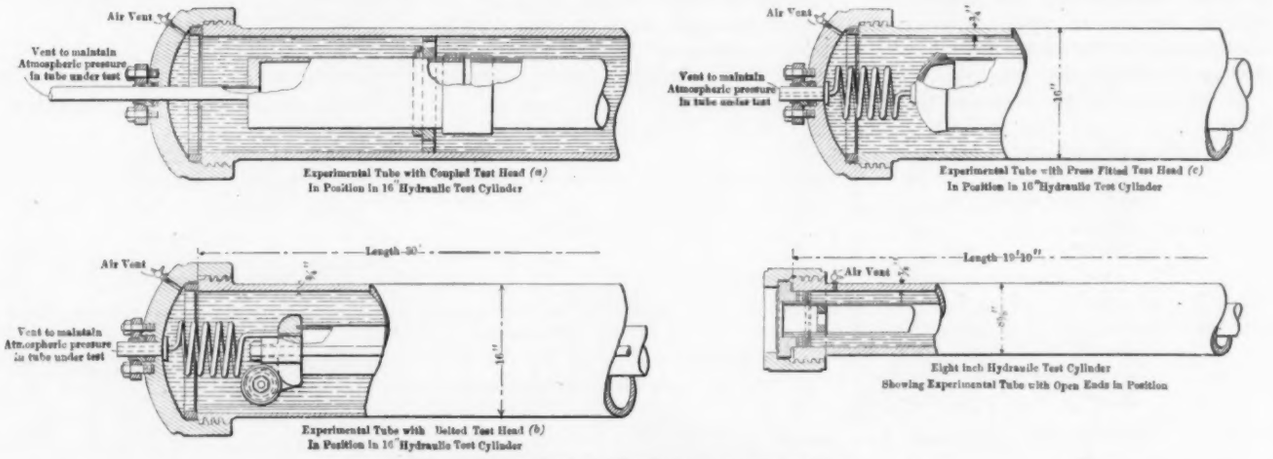

Air Vent
Vent to maintain Atmospheric pressure in tube under test
Experimental Tube with Coupled Test Head (a)
In Position in 16" Hydraulic Test Cylinder
Air Vent
Vent to maintain Atmospheric pressure in tube under test
Experimental Tube with Press Fitted Test Head (c)
In Position in 16" Hydraulic Test Cylinder
Length 30"
Air Vent
Vent to maintain Atmospheric pressure in tube under test
Experimental Tube with Belled Test Head (b)
In Position in 16" Hydraulic Test Cylinder
Length 19 1/2 10 11/32"
Air Vent
Eight inch Hydraulic Test Cylinder
Showing Experimental Tube with Open Ends in Position

FIG. 2. DETAILS OF HYDRAULIC TEST APPARATUS.

The collapsing pressure from curve *M* for each nominal thickness, in the five different lengths tested, were read from a chart similar to Fig. 3, but drawn to a much larger scale. When it is considered that these were the ordinary commercial lap-welded wrought tubes, selected at random, and subjected to an external fluid pressure, it is surprising that there should be such a slight variation. It will be observed that the greatest individual variation does not exceed 22 per cent., while the greatest variation among the group averages is 8.2 per cent., the greater portion of these being less than 5 per cent. The average variation of the group

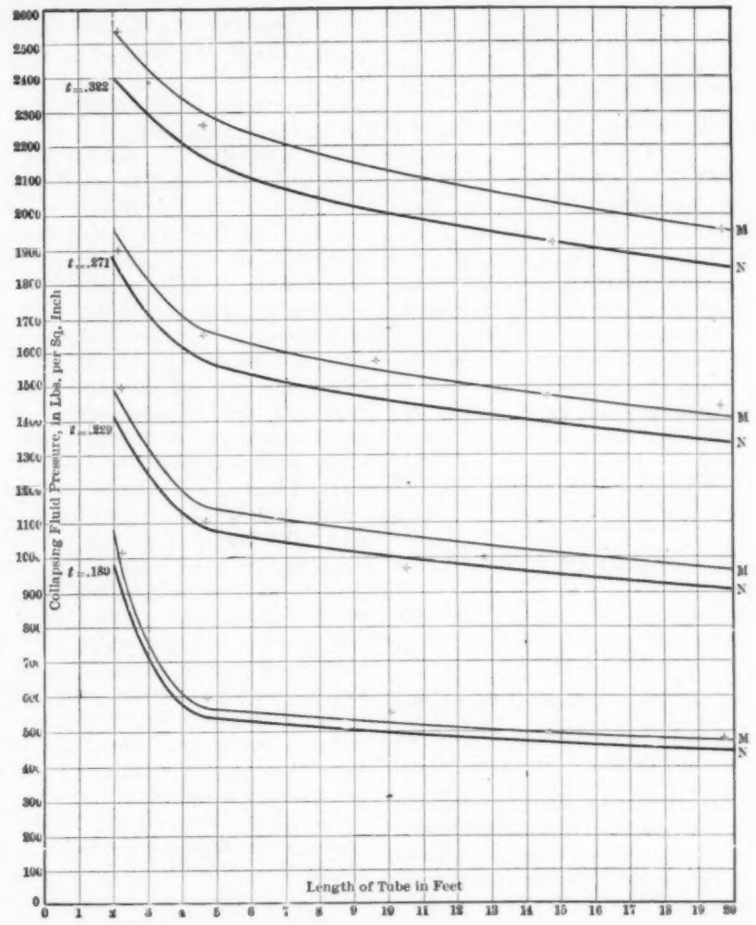


FIG. 3. CHART SHOWING RELATION OF LENGTH OF TUBE TO COLLAPSING PRESSURE UPON TESTS ON LENGTHS OF 2½, 5, 10, 15, AND 20 FEET.

averages is 0.2 per cent. Theoretically, of course, this should be zero, but the very small value of 0.2 per cent. obtained serves as a satisfactory check upon the accuracy of the mean values read from curve *M*.

Relation of Collapsing Pressure to Length of Tube—This relation is clearly shown in Fig. 3 for 8¼-inch casing (8⅝ inches outside diameter) in the four nominal thicknesses of 0.180, 0.229, 0.271, 0.322 inch, and for lengths of from 2 to 20 feet between the regular screwed couplings.

On this plate the combined circles and crosses represent the different plotted averages. By means of these plotted values the curves marked *M* were constructed. The spacing of these curves was adjusted so that when the values were also plotted to collapsing pressure and thickness, for each of the five lengths tested, the resulting curves were smooth. By this method of cross-plotting the individual experiments on 8⅝ inches outside diameter tubes, the four curves marked *M* were obtained. Each of these curves then, is not based only upon the group averages belonging to it, but is also based upon the group averages belonging to the other three curves similarly marked.

The curves marked *N* were obtained by adjusting the curves *M* so as to harmonize with the most probable values for collapsing pressure as based upon series two. The difference, it will be observed, is small, the different curves *N* being only 5.6 per cent. below the corresponding curves *M*.

It must be remembered that this chart applies strictly only to tubes having an outside diameter of 8⅝ inches.

Discussion of Curves M and N—An inspection of Fig. 3 discloses the fact that for this size of tube, namely 8⅝ inches outside diameter, there is a marked dropping off in collapsing pressure as the length of the tube is increased up to about 4½ feet, or until a length equal to about 6 diameters is reached. Beyond this point there appears to be no further material decrease in the collapsing pressure. For example, from curve *M*, for a thickness of 0.180 inch, the collapsing pressure for lengths of 2, 4½ and 20 feet are respectively 1050, 570, 480 pounds. That is to say, an increase in length from 2 to 4½ feet diminishes the collapsing pressure by 480 pounds, while a further increase from 4½ to 20 feet in length diminishes the collapsing pressure by only 90 pounds. As the thickness of wall is increased this disparity between the relative strength of long and short tubes becomes less prominent until for a thickness of 0.322 inch the difference is so small as to be of no practical importance.

Assuming 20 feet to be the standard length of tube between end connections tending to hold it to a circular form, we find from curve *N*, for a thickness of 0.180 inch, that for lengths of 20, 15, 10, 5 and 2 feet the respective collapsing pressures would be 450, 470, 500, 540 and 980, which correspond to increases of 4.5, 11, 20 and 118 per cent. respectively.

For a thickness of 0.322 inch the values of the collapsing pressures for the same lengths are 1850, 1915, 2000, 2140 and 2390, which correspond to increases of 3.5, 8, 16, and 29 per cent. respectively.

A study of these curves *M* and *N*, taken in connection with photographs of the experimental tubes after being collapsed, will show conclusively that for lengths greater than about six diameters the strength of a tube when subjected to a fluid collapsing pressure is substantially constant. It must remembered, that the inability to stop the hydraulic pressure pump instantly the experimental tube failed, together with the recoil of the hydraulic test cylinder, will account for an extension of the length of the collapsed portion by probably two or more diameters, after failure had actually occurred.

COLLAPSING TESTS, SERIES TWO, ON TWENTY-FOOT LENGTHS, SHOWING THE INFLUENCE OF DIAMETER AND THICKNESS OF WALL ON THE COLLAPSING PRESSURE.

The purpose of series one was to determine the precise nature of the influence of length of tube upon the collapsing pressure. By length of tube is here meant the distance between couplings, or other end connections, of a single length of tube, tending to hold it to a circular form. The experimental determinations constituting series one, and Fig. 3, show conclusively that for commercial wrought tubes 8⅝ inches outside diameter, there is no practical difference in the collapsing pressure for lengths greater than six diameters up to twenty feet. As soon as this point had been fully established experimentally it was decided to make all succeeding tests on tubes in lengths of 20 feet. This was accordingly done, the

results of these tests being grouped as series two.

The apparatus used, and the manner of making the tests of series two were, in every essential respect, precisely the same as for series one.

DERIVATION OF FORMULAS FOR THE PROBABLE COLLAPSING PRESSURE OF LAP-WELDED BESSEMER STEEL TUBES FOR LENGTHS OF TWENTY FEET.

Plotting group averages to $\frac{t}{d}$.—It is apparent that for tubes subjected to external fluid pressure there are three principal variables involved, namely, the outside diameter, d, the thickness of wall, t and the fluid-collapsing pressure, P. It is also apparent that each of these variables is a function of the other two, that is to say, depends jointly upon each of them for its value.

After a fruitless effort to derive a satisfactory formula on the basis of three variables, which, when plotted, would, of course, be a surface in space, the thought happily presented itself that two of these variables, t and d, could be replaced by their quotient, or $\frac{t}{d}$ which, of course, might be treated as a single variable. By the adoption of this expedient, matters were greatly simplified, since it thus became possible to plot the results of the tests for all diameters and thicknesses of wall on a plane surface.

Formula B—By an inspection of a chart showing the group averages plotted in this manner it became apparent that the bulk of the group averages could be represented by a straight-line formula, indeed all of them could be thus represented with the exception of the few having values of thickness divided by outside diameter less than 0.023. In other words, about 93 per cent. of the group averages can be thus represented.

On this basis then, for values of $\frac{t}{d}$ greater than 0.023, formula (B) was deduced, it being as follows:

$$P = 86{,}670\,\frac{t}{d} - 1386 \qquad (B)$$

Where P = collapsing pressure, lb. per sq. inch,
d = outside diameter of tube in inches,
t = thickness of wall in inches.

Remembering that this same formula might also have been arrived at by the substitution of proper empirical constants in a similar formula for a theoretically perfect tube, and further, since the chart shows no apparent deviation from straightness on the upward course, it was not thought necessary to set an upper limit to the value of $\frac{t}{d}$ in the application of this formula, believing that it will give substantially correct results for all commercial lap-welded bessemer steel tubes whose thickness divided by the outside diameter is greater than 0.023.

Formula A—This formula for values of $\frac{t}{d}$ less than 0.023 was derived upon the assumption that when plotted upon the chart the resulting curve should be tangent to the straight line representing formula (B) and be also tangent to the horizontal axis at the origin. This arbitrary assumption gave a formula which represented very satisfactorily the few experiments in which $\frac{t}{d}$ was less than 0.023. The formula thus obtained is

$$P = 1000\left(1 + \sqrt{1 - 1600\,\frac{t^2}{d^2}}\right) \qquad (A)$$

Where P, d and t are the same as for formula (B).

This formula should be used for values of $\frac{t}{d}$ less than 0.023 and for P greater than $\frac{1}{22}\sqrt{d}$.

Since constructing the charts and tables contained in this paper, it was discovered that a formula having a rational form with empirical constants could be substituted for the purely empirical formula (A). This formula, in addition to involving theoretical considerations of elasticity, is much the simpler of the two. It is applicable only to tubes having relatively thin walls, that is to say, to those having values of $\frac{t}{d}$ less than 0.023, and is

$$P = 50{,}210{,}000\left(\frac{t}{d}\right)^3 \qquad (G)$$

Where P, d and t are the same as for formula (A).

Either formula (A) or (G) represents satisfactorily the results of the experiments made on thin-walled tubes, that is, those in which $\frac{t}{d}$ is less than 0.023, but probably formula (G) will permit of the greater exterpolation.

The theory that the sum of the tensions in both runs of a belt is constant, has been questioned, as the result of experiments at the Worcester Polytechnic Institute. According to Prof. W. W. Bird, the tests showed that, as the load comes on, the tight side of the belt stretches more than the slack side contracts, with the result that the sum of the tensions increases and thus brings a greater pressure on the bearings. Professor Bird explains this by the variation in the modulus of elasticity due to the element of time; if the belt were non-elastic like a chain drive, the pressure on the shaft bearings would increase directly as the load, while if the belt were perfectly elastic and could stretch and contract instantly the pressure would remain constant.

The enormous consumption of aluminum in the motor-car industry and for purposes formerly depending altogether on copper and brass, is making it difficult to secure ample supplies of it.

Letters to the Editor.

Experience with Two Varieties of Tool Steel Under Different Conditions.

In making some repairs and renewals to an automobile an experience with two varieties of tool steel was met with which illustrates very well the adaptability of different steels to different conditions.

A steel casting forming part of the clutch mechanism was very badly worn, and as a new one was not obtainable, it was decided to renew the wearing surfaces by brazing in a split ring of steel and then turning the necessary groove in the new stock. As the wear on this piece had proved to be rather severe, the new piece was made of tool steel in the hope of making a more lasting job of it.

The man who did the brazing must have allowed the work to cool too rapidly, for when it was placed in the lathe it was found so hard that it was almost impossible to cut it. It was decided that it would not be advisable to anneal the work for fear of doing damage to the brazing, and therefore a determined effort was made to machine it as it was.

Various tools of different brands of steel were tried without success, including a very good self-hardening steel and some of the best-known brands of carbon steel. Finally an effort was made with a certain high-speed-steel tool, which proved about the worst of the lot. This tool would not cut at all, two or three revolutions of the work being sufficient to crumble the cutting edge off the tool. As a last resort a tool was made of another kind of steel, which was on hand, and this tool did the work without much difficulty. It should be noted that in all these trials various speeds were used, and it was found that the slower the speed the better the result in every case.

The next piece of work done after finishing this hard piece was on a forging for a gear blank. This forging was made of a rather hard grade of machinery steel and was so large that it would only just swing in the only lathe available. This lathe being generally used for much smaller work, was speeded too high for a job of this size, and, in fact, it was found that the slowest speed that could be given to the work was 42 feet per minute. Under these conditions the tool which had given such good results on the hard steel was put to work, but somewhat to my surprise it failed almost at once. Several trials were made, but to no purpose; the forging was not unusually hard, but the tool simply would not cut it at the speed it was running.

Next the tool which had utterly failed with the "hard" job was tried on this softer but faster-running one, and the results were all that could be asked; the "high-speed" tool was now quite at home and

cut as freely at 42 feet per minute as a carbon-steel tool would at one-third that rate, which only proves again that the steel should be selected for the duty required, and that a steel which is excellent for one case may easily prove worthless in another.

I use the tool-holders which employ short pieces of square steel fastened with set-screws, and I find it a great convenience to keep a liberal assortment of cutters on hand to fit, made of various grades of tool steel, all with proper identification marks to indicate the brand of steel they are made from. In this way it is an easy matter always to select a certain steel for a particular duty, and often with a decided saving in time over another grade or brand.

E. P. CLARK.

Machining Brass Rings.

The two chucks, Figs. 1 and 2, are used for holding cast-brass rings during the operations of boring, facing the sides and turning the outside diameter. The rings form part of a turbine type of water meter, are lightly constructed and have a number of projections from the inner side of their walls. The walls of a ring 10 inches in diameter are 5/32 inch thick and 2½ inches deep. When finished, the rings must be absolutely true and show no distortion due to improper handling.

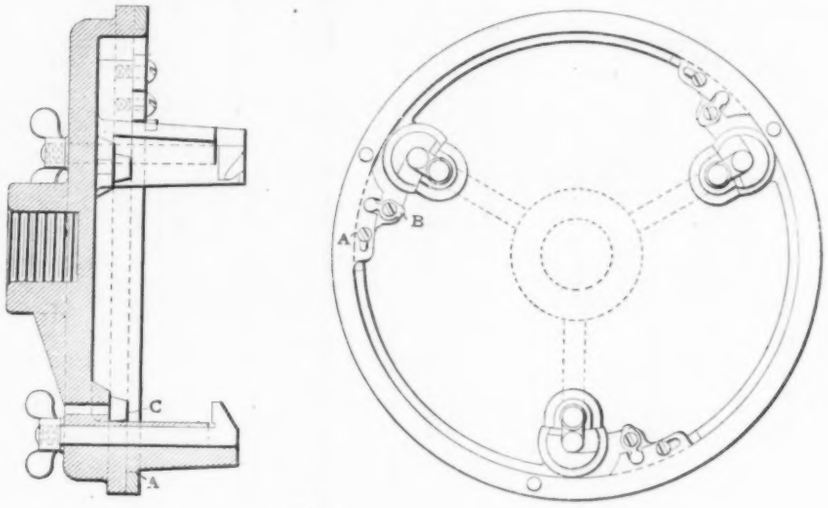


FIG. 1

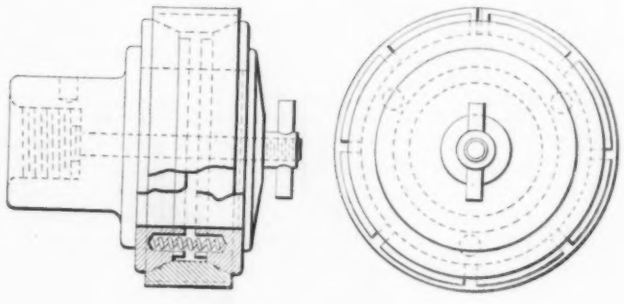


FIG. 2
CHUCKS FOR HOLDING BRASS RINGS.

The chuck Fig. 1, holds the rings for the boring operation. Its body is made of gray iron, and is bored and threaded to fit the nose of the spindle of a turret lathe. The centering device, consisting of the machine-steel ring *A* and the three levers *B*, permits rapid and true chucking of the rings without distorting them. The rings are brought against the three hardened tool-steel banking points *C*; then the free moving ring of the device is turned until the three levers touch them lightly and center them, and then the clamps are tightened. These hardened tool-steel clamps are so constructed and placed that the points coming in contact with the rings are of the same shape and size as the supporting points *C* and are in perfect alinement with them to prevent any tilting strains on the rings when brought down tight.

The chuck, Fig. 2, is of the expansion variety, and holds the rings for turning the outside diameter and for facing the sides. Its body is made of gray iron. Two annular wedges, or cones, of tool steel, hardened and ground, expand the split carrying ring, which is also of tool steel and made flexible enough to yield to the resistance of the brass rings and bring all of its bearing points in contact with the annular wedges when the clamping nut is tightened. When the nut is loosened, three helical springs force the movable cone outward to allow the carrying ring to contract.

Fig. 3 shows one of the drilling jigs for the rings. It is made up in two parts, and is fitted with tool-steel bushings and alinement dowels which are hardened, ground and lapped. Eight holes are drilled in each side of the rings, and are located so that when the rings are brought into position with either side or at any point the holes will match up. The rings fit on shoulders on each part of the jig, and are located by two stop pins in the lower part. The upper end of the clamping stud is reduced to the diameter of the bottom of the thread to allow the clamping nut to be spun on and off easily.

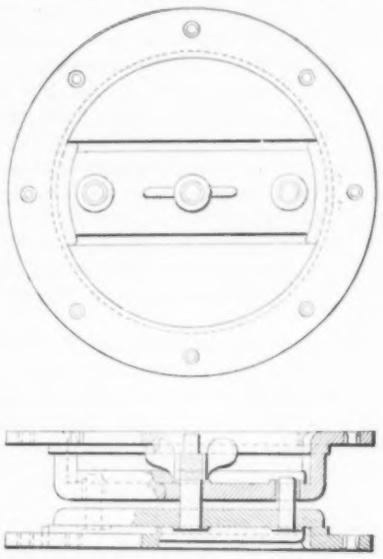


FIG. 3. JIG FOR DRILLING BRASS RINGS.

H. E. R. MANBRAND.

"Clockwise" and "Counter-Clockwise," not "With" or "Against the Sun."

Recently there was in your columns a very interesting description of a friction speed gearing for giving motion to a cream separator which your correspondent saw in Sweden. In the description, use was made of the terms, "against the sun" and "sunwise" to indicate the direction of motion of some wheels in the machine. This is right only for the North latitude, but I think all writers of technical literature nowadays should remember that their writings are likely to be read in many other parts of the world, and reference to the motion of the sun to describe motions of machinery should never be used in any case because it is unnecessary and may cause confusion and error. Wherever there is civilization enough to call for technical literature the people are all familiar with clocks and watches, and so far as I know, the world over, clocks and watches all run in the same direction, and it will therefore be universally accurate to refer to the motion of the hands on them to indicate the direction which is to be described. This may be con-

sidered a small matter by some, but when it is just as easy to make it universal as not there is no good reason why it should not be so. BELL CRANK.

Roll Grinding.

J. H. Hollinger, at page 712, asks, in reference to my article on Roll Grinding, if rolls can be ground on two dead centers true and concentric, regardless of weight? My answer is "Yes." He asks "Why grind on such small bearings when you have true journals?" I would ask how he is going to grind the journals if he does not grind on center holes, and if the center holes are large enough to grind the journals true, they are certainly large enough to grind the bodies of the rolls true.

Mr. Hollinger assumes that he has a roll weighing 500 pounds, and speaks of its requiring some time to finish, and asks if two small centers would support this weight when rotating and remain true. I answer no, and if he will carefully read my article he will see that it is a protest against small center holes, the burden of the entire article being that center holes in rolls are too small. If, however, the 500-pound roll has really 60-degree center holes, at least 1 inch across the mouth of the hole, he can grind the roll with the body and the journals perfectly concentric and perfectly round, if the center holes are round.

The interesting feature of this discussion is the fact that rolls weighing 2000 pounds are ground successfully on centers—both the roll body and the journals—and the roll and journals are concentric and both are round.

Mr. Hollinger speaks of requiring some time to finish the roll. There may be some misunderstanding here. A modern grinding machine does not require much time to finish a roll. A pair of rolls weighing 2000 pounds each, were ground all over, removing 1/32-inch from the roll body, and truing up the journals, in two hours for the pair.

He asks, "If the journals are true before grinding the body, will they remain so until the operation is completed?" My answer is yes, if he has a center hole of the correct angle and large enough for the weight. For a 2000-pound roll the center holes should be 2 inches diameter at the mouth. It is not customary, however, with the modern grinding machine, to grind the journals first. The body of the roll is first roughed out. The journals are then roughed out approximately. The body of the roll is then finished and the journals finished immediately afterward, it requiring only about five minutes to finish each journal. It is past comprehension that a center hole 2 inches in diameter, having an accurately ground 60-degree center, can wear out of truth in ten minutes.

In regard to the wear of the journals of

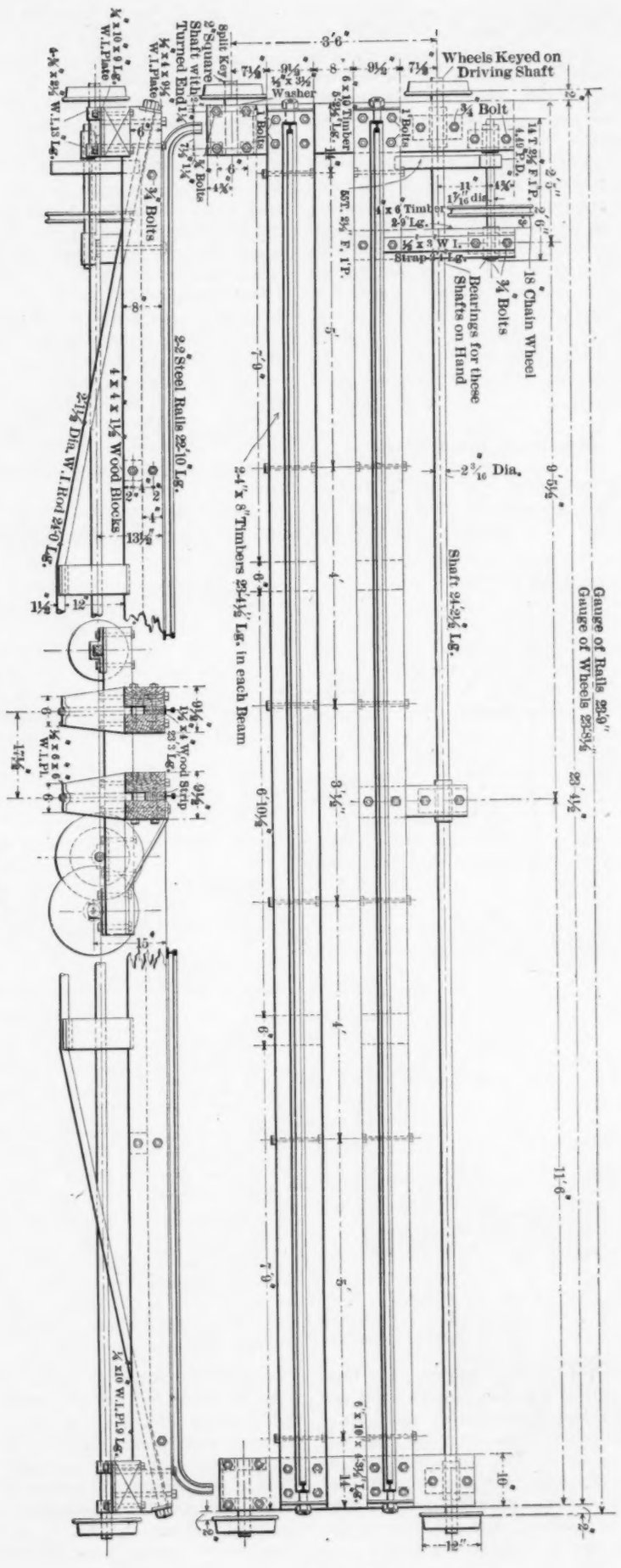


FIG. 1. A MEXICAN HOME-MADE CRANE.

which he speaks, this is caused by the enormous pressure in crushing metal with the rolls, and they are supposed to be under this pressure sometimes for days and weeks. The revolution of the roll while grinding the journals should not exceed in all, with a careless workman, more than twenty minutes.

My contention is that rolls do have too small center holes and that is the reason why roll grinders have adopted the use of the journal to grind the rolls on. Center holes in rolls should run from ½ inch across the mouth for very small ones to 3 inches diameter for large ones.

If Mr. Hollinger will read my article again he will see that it is my belief that ordinary rolls do not have round center holes, and they are not 60 degrees, but rather are more apt to be 90 degrees, an angle that will wear out of truth, regardless of its size, in a short time.

This whole matter is simply one of common sense. We cannot expect round journals if we do not have round and large enough center holes. We cannot get round roll bodies unless the journals on which they revolve are round. No amount of juggling or theorizing can change these laws, and if the center is sufficiently large and accurate enough to grind the journal, the grinding of this journal on the last finishing cut requires but a few moments. Consequently, if you can grind the journal round you certainly can grind the body of the roll round. It is not a theory; it is a fact. Rolls are ground in that way, and are successful. C. H. NORTON.

A Mexican Home-Made Crane.

Thinking that perhaps the readers of the AMERICAN MACHINIST would be interested in the way we do things in Old Mexico I send drawings of a home-made crane. We built a machine shop a while ago, and among the required equipment was a 3-ton crane, but because of high freight and custom charges the chief thought we could build it for less than we could buy it. At that time a somewhat similar crane to what we wanted was described in the AMERICAN MACHINIST, at page 695, Vol. 28, Part 2, which gave us confidence and I was set to work on it, and the drawing shows the result. The article referred to was chiefly useful in giving us a starting point, the design as finally adopted differing considerably from the one there shown. The crane has come fully up to expectations in the matter of cost, nothing but the rough iron having to be imported, except the 3-ton chain hoist, the rest being mostly from scrap, with native timber for the bridge. The construction was necessarily light because one end of the crane is carried on a girder hung from the center of the roof truss which has a span of 50 feet, the crane covering half the width of the shop. I include a sketch of the truss connection which may be of interest. The building is of Mexican adobe or sun-dried brick, which has a very low bearing value which limits the hight of the walls and therefore the head room, so that the crane was required to operate in a space of 3 feet below the truss. We took up a little more than that with the camber rods, but kept within a very satisfactory limit, and the crane works very smoothly, both the bridge and trolley moving easily under load, the heaviest load being an 18-inch lathe with about a 12-foot bed.

E. J. H.

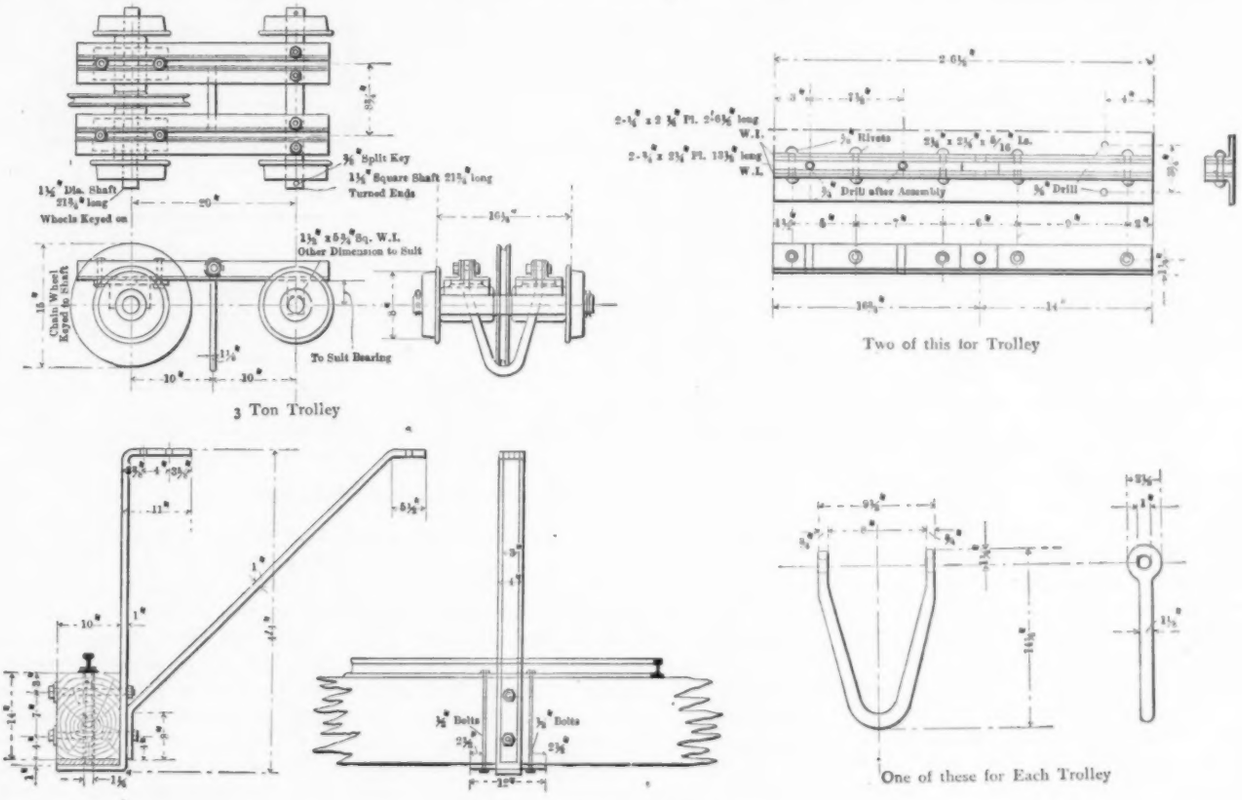


FIG. 2. DETAILS OF CRANE.

Photographing Blue-prints.

One of our subscribers who tried the process described at page 613 by Mr. Suplee, did not get as a result the sharp definition and satisfactory coloring desired in the print. We sent his sample print to Mr. Suplee, who was kind enough to send further suggestions to the subscriber, and who has sent us a print which he toned himself, cut in two to show the effect "before and after." The color after treating is a brown with a purplish tinge, and the lines are very nearly as white as on the untreated blue-print. Mr. Suplee makes the following remarks:

Referring to the inquiry about the unsatisfactory results obtained in toning blue-prints for photographing, I cannot altogether account for the poor effect, although it seems probable that the original blue-print had considerable blue in the lines, which naturally toned with the background. I think it is probable that both solutions were used too strong; a few drops, or say half a teaspoonful of ammonia in a glass of water is enough for the first solution, and a heaping teaspoonful of dry tannic acid powder in a glass

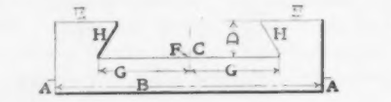
of water for the second. Possibly the print was not washed carefully enough between the baths. H. H. SUPLEE.

Table for Dimensioning Dovetail Slides and Gibs—Planing Cross Slides, Etc.

H. F. N.'s table of angles at page 361 reminds me that when I first struck a job of machine-tool drafting I found one of these tables in the office. I thought it was a great thing and began to use it. Then the foreman machinist came around and invited me to come out and see how he was in the habit of planing up such a job. Fig. 1 illustrates his method, showing a partial end view of a cross slide and front view of a carriage to which it was to fit. He began by roughing off the top of the slide and then turning it over, ran down each edge about a quarter of an inch at *A A*, taking the same off each side to bring it to the dimension *B*. Then he roughed out with a round nose tool, the middle part at *C*, and by means of a thickness block equal to depth *D* set the tool to plane off surfaces *E E*. The next thing was to lay out the center of the width at *F* on the end and then to lay off dimensions *G G* on each side and scribe the starting lines *H H* (60 degrees in this case). These were to plane to for the bevels. The finishing was done to these lines with a tool flatted off on the point to about 1/16 inch, no matter what size tool it was for. This flatting off as H. F. N. suggests at page 677, was done on a vertical line for convenience.

The carriage was planed in a similar way. Places *KK* were roughed out first and then the tool raised the hight of this same thickness block, and the top of the carriage roughed out. The center of the cross slide was found at *L* and the distances *M*, *N* laid off, *N* in this case being less than *M* to allow for the packing. This laying out and planing then went on the same as for the other piece. This process gave me no chance to use the table of angles, and as it worked it was all right. I think draftsmen, while they use center lines themselves, are apt to overlook the fact that machinists are very apt to do the same.

We used a few taper packings or gibs, not enough to pay to rig up for. The method followed in planing was wrong, but it worked well, so I will give it here for the benefit of anyone who is situated the same as we were. The taper gib was planed first. All taper gibs which we used had the same taper, about ⅛ inch per foot, so we had a strip like a parallel, except that it was planed on one side to this same taper. This was laid on the planer table and the strip to be planed laid on top. When we were ready to plane the slide into which this packing was to fit it was carried along just the same as usual, except that one of the sides *O*, Fig. 2, was planed clear across and set up against an angle iron *P* for planing all of the sides except *Q*. When ready to plane side *Q* the taper gib or packing was put in at *R* and the planing proceeded with. As this did not bring a good fit a piece of tin was slipped in at *S*. A little experience gave the thickness of this tin all right and then it was saved. That is, it was put away where the man that did the planing could find it when he wanted it. Before another of these jobs came along he had quit and the shop was up a stump. I volunteered a suggestion as to the thickness, and it was tried and



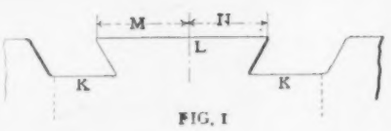


FIG. 1

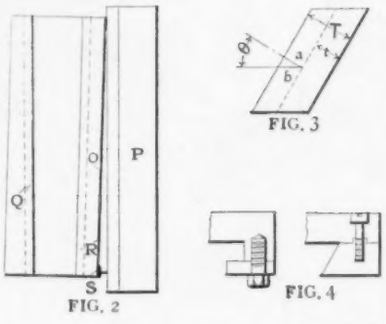


FIG. 2

FIG. 3

FIG. 4

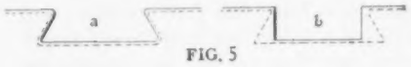


FIG. 5

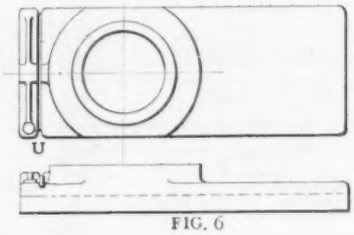


FIG. 6

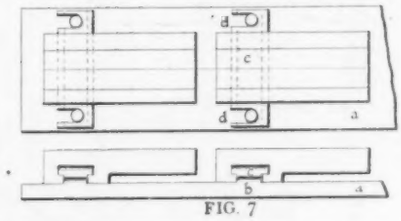


FIG. 7

PLANING CROSS SLIDES, GIBS, ETC.

came out all right, to the planer hand's surprise. Fig. 3 shows how I got at it. This is an end view of a packing piece. *T* is the thickness at the thick end and *t* at the small end. $T-t=a$ which was the amount the slide was originally set round for planing. The amount it should have been set round was *b*, measured on a horizontal line. θ is the angle between *a* and *b* and is the amount that the planer head is set out of the vertical; $b-a$ is the thickness of the tin that we must put in to compensate for the error.

$$b=\frac{a}{\cos\theta}$$

$$b-a=\frac{a}{\cos\theta}-a$$

For a slide 12 inches long on a taper of ⅛ inch to the foot where $\theta=30$ degrees we would have

$$b-a=\frac{⅛\ inch}{.866}-⅛\ inch=0.019\ inch,$$

quite a substantial amount to put in.

By the way, are these pieces, "packings" or "gibs?" The terms are badly muddled in ordinary speech. I have always considered that a piece which was put in to fill a space and to take up wear was a packing and that a piece which was put on as in Fig. 4, whether adjustable to take up wear or not, was a gib. If I am wrong I hope some one will jump up and say so.

This foreman and I had scraps every little while as to the advisability of having the dovetails cored in the various pieces as at *a*, Fig. 5, or leaving them square as at *b*. I finally inclined to the latter. If they are cast like *a* you are planing on scale all the way. If like *b*, you have to plane out more metal but after the first chip down you have gotten rid of the scale. The cost of the extra iron in form *b* is almost nothing for depths of less than 1 inch, and if you are running your own foundry the cost of cutting out the iron is greater than the cost of iron saved. Over 1 inch depth there is not much doubt that for planing operations it is cheaper to core it out. For milling I should think the limit might be greater.

There were two other schemes in use in connection with this planer job that were worth while. One was for making the screw gage which clamps on the carriage in front of the cross slide. Fig. 6 shows the top and side view of one of the cross slides with the screw gage cast on with about ⅛ inch of metal at *U* to allow for sawing off after the planing was done. The slides were planed right through in strings and then the gages were sawed off on the miller. The little gib pieces to fasten the screw gages to the carriage we planed up in long strips and sawed off as wanted. A few minutes shaper work to each piece fitted the gib on. These screw gages are mean things to string along on a planer and it is a great loss of time to work out two at a time on a shaper so this method effected a great saving.

Another scheme was for holding the top slides for compound rests on the planer and is shown in Fig. 7 where *a* is a long strip fastened lengthwise of the planer with raised crosswise strips as at *b b*, to fit the tool post T-slots. Through each of these slots a loosely fitting gray-iron strap *c* was slipped. This was bolted

down to plate *a* by a bolt at each end. The bolts ran through slots in the cross straps at *d* instead of holes, so that when taking the work off the bolts had only to be slacked a trifle more than the thickness of crosswise tongues *b*.

ENTROPY.

Setting Automatics.

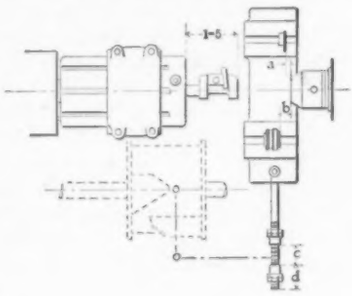
I have tried several ways to make the setting of automatic screw machines more systematic and have come to the conclusion that great advantages can be obtained by using the following method:

Where the cam drums are graduated on the periphery, as in Fig. 2, it is only necessary to note the numbers to which the marks *A B C D* of the cams are set. The distance *e* from the face of the cam drum to the bracket of the wire feed bar and the distance *f* are found by measuring. In determining the situation of *E* relative to the cam drum at the moment when the stock feed takes place, a square (shown by dotted lines) is laid on the edge of the drum to show what graduation is situated directly opposite the corner *F*.

The tool feeds can be fixed by measuring the distances from the out-

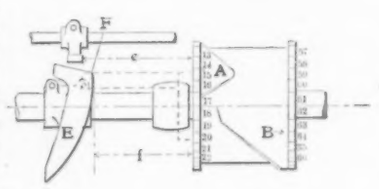
Piece No.			Tool No. 1	2	3	4	5	a	b	c	d	Ref. of Countershaft
1		Set Screw	67.5	83.5	81	0	114	6.5	8	46	50.5	400
2		Nut	66	84.5	79	0	109	5.5	9	44	48.5	500
3		Shell Screw	78	91	84	77	115	6	8.5	41	50	450
4		Joint Bolt										
5												
6								Dimensions				m/m

FIG. 1



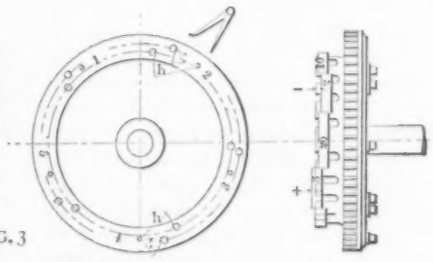
Piece No.	Cams A	B	C	D	e	f	F
1	14	66	70	40	150	140	14½
2	14	66	70	40	150	"	"
3	15	63	72	40	162	129	16
4							
5					Dimensions		m/m

FIG. 2



Piece No.	Feed 1	2	3	4	5	Change No. 1 g	h	2 g	h	3 g	h	4 g	h	5 g	h
1	0	4.3	1.5	0	11	0	0	48	71	64	77	0	0	34	62
2	0	3	2	0	9	0	0	45	66	63	75	0	0	38	67
3	0	3	1	1.5	10	0	0	41	67	58	58	38	62	41	72
4	0														
5	0														
6															

FIG. 3



SETTING AUTOMATICS.

For example a Cleveland automatic is taken. The design is so well known, that of course, the accompanying sketches will be sufficient for explanation.

After the machine is set for a piece of work which is turned out to the right dimensions, the positions of the tools and certain machine parts on which the accuracy of the piece depends, are measured from given points and noted on a table.

The turret tools are numbered and the distances from the edge of the turret to the cutting edges of the tools are recorded as in Fig. 1. In the same manner the distances from the face of the chuck to the cut-off tool *a* and the forming tool *b* are taken and also the distances *c* and *d* giving the locations of the cut-off slide stop nuts on their rod.

side edge of the slotted disk, Fig. 3, to the sliding pieces Nos. 10, 2, 20, 3, and so on. To save time in bringing to position the tools for the several operations the accurate setting of the speed change dogs *g-h* is very important. In order to fix their positions marks are made by a center punch at the points 1-5. The distances from these marks to the dogs can be taken easily by using an hermaphrodite caliper as shown in the sketch. In the same way the positions of the belt shipping dogs and other parts can be fixed. It is advisable to sketch the different pieces made, as in Fig. 1, and dimension them.

If, for instance, piece No. 1 is to be made again, any man versed in automatic machinery will be able to set the machine accurately in a very short time by referring to the tables. Where a piece is made on the automatic for the first time, the tools can be set at least approximately by comparing the dimensions of the new sample with those of some piece made before, and it is then only necessary to adjust the setting. The data may be arranged on cards, in a single sheet as shown, or written in a book.

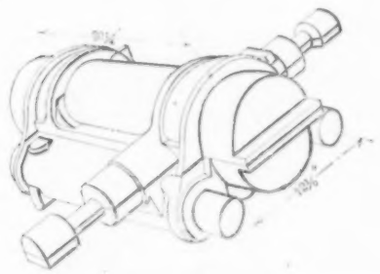
The method described has been used on many automatics and it has given great satisfaction. It has enabled work to be made in small lots more advantageously than before, because the time for setting the machines has been reduced to a minimum.

FRITZ SCHKOMMODAN.

Leipzig, Germany.

The Making of Perspective Views Without Skill.

It sometimes happens that a perspective picture is wanted, either for an assembled view, accompanied by a mechanical drawing of the part, or for other reasons, where a skilled artist is not available (and if he was his time would cost too much to warrant its being used). It is here a



OUTLINE OF PATTERN.

camera comes into play as a drafting tool.

We will suppose, for illustration, that bids for a casting are required, where the patterns are furnished, and it is desired to mail the foundry people blue-prints showing the nature of the work.

A photograph can be taken of the pattern and from the negative a blue-print made, and outlined in pencil emphasizing any points to which especial attention is to be called. The print is then dipped in sodium hydrate, or common lye will do very well, when the blue at once turns into a pale yellow, leaving the pencil outline standing out in bold relief, as in the sketch.

It is then a small matter to trace, free hand, the outline on tracing-cloth, making a neat, correct picture of the work at a small cost.

GEORGE F. SUMMERS.

According to Consul Bergh of Gothenburg all the streams of Sweden with a fall of water sufficient to generate electricity are soon to be harnessed for industrial purposes. It is intended to make the price on the electric power so low that it can compete with the cheapest motive power obtained in any other manner.

American Society for Testing Materials, Atlantic City Meeting.

The A. S. T. M. opened its 9th annual meeting upon the top floor, or Logia, of the Chalfonte hotel, Atlantic City, N. J., June 21 at 3 p.m., about 200 members being present at the opening session.

In the absence of President Charles B. Dudley, Vice-President R. W. Lesley presided.

The registration book was not opened until the hour of the meeting and there was some delay in getting names of members and in attending to the railroad certificates, but when once under way things went along with great expedition, many of the members, and " the chair" as well, smoking, as they discussed things. Reading of the minutes of the previous meeting was dispensed with and the annual report of the Executive Council was presented, showing a very gratifying growth and condition of the society, which now has about 850 members and publishes transactions to the extent of 565 standard pages. Its pecuniary affairs are also in a satisfactory state and it is no longer in the condition of having to accept contributions from any source.

Prof. Gaetano Lanza then presented a collection of memoirs of "Deceased American Investigators who have Contributed in a Marked Degree to the Advancement of the Testing of Materials." This had been prepared originally at the request of the International Society for Testing Materials, and to be published by that society, but a change in its plans brought about by the death of Professor Tetmajor had postponed its appearance for some time, and the American society had taken it up. It is an excellent and valuable piece of work, containing portraits and carefully prepared accounts of the work of Bvt. Major William Wade, 1789-1875; John A. Roebling, 1806-1869; Bvt. Brig General Thomas J. Rodman, 1815-1871; James B. Eads, 1820-1887; Col. Theodore T. S. Laidley, 1822-1886; Col. Henry Fladd, 1824-1898; W. E. Woodbridge, 1824-1904; Major General Quincy A. Gillmore, 1825-1888; Col. William H. Paine, 1828-1890; Alexander L. Holley, 1832-1882; Rear Admiral Lester A. Beardslee, 1836-1903; Robert H. Thurston, 1839-1903; Louis F. G. Bouscaren, 1840-1904; George S. Morrison, 1842-1903; John B. Johnson, 1850-1902, and Alfred E. Hunt, 1855-1889.

Two papers were read on road materials—behavior of various kinds of stone used in road building—purely civil engineering papers, after which there was a report of a committee on "Fire Proofing Materials" presented by Prof. Ira H. Woolson, the specialist in that line. In presenting the report Professor Woolson said that at his request 20 cards had been printed by various American and foreign technical journals asking for information regarding tests that might have been made. The only reply had come from the editor of a German technical paper. There was also a report of progress by a committee on specifications for timber. At this session votes were received and counted for officers of the society for 1906-1908, resulting in the election of a ticket which had been previously printed and to which there was no opposition: President, Charles B. Dudley; vice-president, Robert W. Lesley; secretary-treasurer, Edgar Marburg; member of the Executive Committee, James Christie.

SECOND SESSION.

In the evening session Vice-president Lesley presented the annual address, which reviewed the history of the society in an interesting way, after which there was a paper on Concrete "Column Tests at Watertown Arsenal," by J. W. Howard, who described and showed upon the screen large reinforced columns which had been tested to destruction in the large Emery testing machine. Then Richard L. Humphrey showed upon the screen and described a large number of photographs showing the results of the earthquake and fire at San Francisco. These photographs had been taken by Mr. Humphrey, or under his direction, and he showed a comprehensive and detailed knowledge of the subject which made his talk exceedingly interesting.

Dr. S. W. Stratton, who was to have presented at this session a paper on the "Bureau of Standards" was unavoidably absent and the paper was not presented.

FRIDAY MORNING SESSIONS.

There were two meetings Friday morning, held simultaneously, the one considering cements and concrete, and the other iron and steel.

J. P. Snow, who introduced the latter subject in a paper entitled "The Corrosion of Steel as Affected by its Chemical Composition," said that he hoped merely to draw out discussion which would add to the knowledge of the subject, stating at the same time that about the sum of his own knowledge of the matter was that steel rusts rapidly, and he gave instances of such rapid rusting, and as an illustration of the popular belief that steel rusts much more rapidly than wrought iron, mentioned diagonal braces crossing each other at their centers and both therefore subjected to exactly the same conditions in every respect where one of these braces had rusted almost entirely away and the other was almost entirely free of rust. The rusted one was found to be of steel, while the unrusted one was of iron. In the discussion which followed numerous similar cases were cited, it being evidently well settled in the minds of many present that steel does certainly rust much more rapidly than wrought iron. There were those who doubted this, however, and who thought the impression was due to inaccurate observation; to the fact that much more steel is used now than formerly, and that electric conditions are now such that both steel and iron are liable to be attacked by electrolysis. Prof. Henry M. Howe thought that the popular idea about it might be wrong and also pointed out the fallacy of certain laboratory tests which were conducted for such a short time as to make the results deceptive. He called attention to the fact that bars of iron had in them strata of cinder and bars of steel strata of cementite, both of which had a tendency to arrest rusting when they were exposed. Loss of weight occurring therefore within a short time might give little or no indication of the relative behavior of a bar of steel and a bar of iron because the one rusting most rapidly at first might afterward rust much more slowly, or, perhaps scarcely at all.

The paper of Maxmillian Toch, entitled "Electrolytic Corrosion of Steel" and the topical discussion on the Corrosion of Iron and Steel, opened by Professor Howe, A. S. Cushman and James Christie, were really added to this and all three discussed together.

Mr. Toch inclined to the belief that much rusting was due to electrolytic action and gave an account of some experiments with buried and moistened specimens, one of which was made an annode while the other was made a cathode, the current used being very light in both voltage and amperage. These experiments sustained his theroy—and he said that Carl Herring had proposed that masses of zinc could be buried in such a way near the grillage of foundations as to make the latter the cathode and thus save the steel by consuming the zinc. Others thought this would be useless because there would be local differences of potential in their structures which would cause the rusting to go on.

Some held that most of the trouble was due to the use of too much scrap in steel making, and to lack of care in making it.

The important difference between loss of weight caused by rusting uniformly over the surface of a bar or by pitting was brought out, especially by Professor Howe, who thought that in this laboratory tests were often at fault, and a member of Teutonic origin, with much "horse sense," experienced and with an active sense of humor, brought down the house by an account of his experience in making tubing for oil wells, saying that if the rusting takes place all in one spot "I dond care what it weighs, if dere iss a hole der water will run through and der tupe iss no goot." J. P. Snow, bridge engineer for the Boston & Maine railroad, said it was plain that steel rusted much more rapidly than iron by the action of locomotive gases, and gave instances to prove it, and another member connected with the National Tube Works, which is

(*Continued on page* 851).

Charles C. Newton.

Charles C. Newton, president and treasurer of the Newton Machine Tool Works, Inc., Philadelphia, Penn., died at Bremen, Germany, June 13. He had not been in good health for some time past and had gone to Europe to seek relief at the baths at Bad Nauheim, but was too ill to continue his journey after his arrival at Bremen.

Mr. Newton was born February 9, 1846, at Cambridge, N. Y., and at the age of 19 he indentured himself as apprentice to the Brooks Locomotive Works, at Dunkirk, N. Y., spending most of his time in the tool room, where the foundation of his successful after career was laid. After serving his apprenticeship, and working in various shops, he returned to Dunkirk, in 1875, and in partnership

CHARLES C. NEWTON.

with J. D. Cox, engaged in the manufacture of twist drills, reamers, cutters, etc. They removed to Cleveland, Ohio, in 1876, to broaden the scope of their work, and operated under the name of Newton & Cox. In 1880 Mr. Newton sold out his interest to Mr. Cox, who formed out of the old firm, the Cleveland Twist Drill Company.

Removing to Philadelphia, Mr. Newton laid the foundation for the present Newton works, in a little shop on Callowhill street, with only himself and an assistant as the working force; in this shop he designed his first heavy railroad tools, and as the demand grew for his various designs, he was forced to seek larger quarters. In the fall of 1886, he built a new shop at the corner of Twenty-fourth and Wood streets, and there designed the first successful machines for sawing metal cold, and also a large number of new tools, for which he took out patents. As this shop soon became too small Mr. Newton built in August, 1895, the first part of the present shop on the corner of Twenty-fourth and Vine strets, which has since increased to take in the entire square bounded by Twenty-third, Twenty-fourth, Vine and Wood streets. He was the sole proprietor of the works until July 14, 1897, when articles of incorporation were taken out, and the firm became the Newton Machine Tool Works, Inc., with Mr. Newton as president and treasurer.

Mr. Newton was held in high esteem by all who knew him, owing to his unswerving honesty and integrity, coupled with his exceptional ability as a designer of machine tools. Having a strong personality, he drew and held many friends to whom his death will come as a great loss, especially to those who have been closely associated with him in his business career.

Mr. Newton was elected a member of the American Society of Mechanical Engineers, at the December meeting, 1904. He was a member of the Engineers' Club, and also a member of the Art and the Athletic Clubs of Philadelphia.

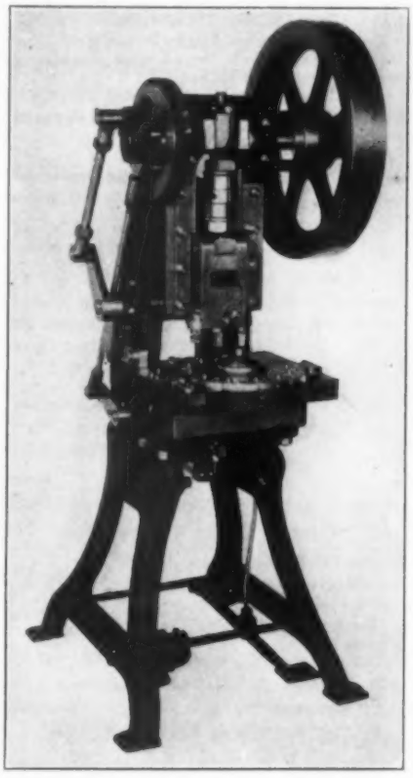
Making Paint Tablets on a Punch Press.

Power presses are ever finding new fields for usefulness. Though originally designed solely for working sheet metals they are now being used with great profit in a large number of other industries, one of the latest of which is the manufacture of water color paints such as children use. The automatic press illustrated was designed for this purpose, but before describing the work for which it is intended we will go back a little to the preparation of the material which is to be worked in it.

After the color has been thoroughly mixed and has reached the consistency of putty, it is taken from the vat and rolled out like pie-crust until it is about one quarter of an inch thick. The material is then cut into long strips about 1½ inches wide by means of a hand-roll like a common rolling pin, but having thin, round cutters at stated intervals. The next operation is done with a similar roll but with cutters only about three-quarters of an inch apart. This roll is moved across the strips and makes small cakes about 1½x¾ inch. These cakes are allowed some time to dry.

Then comes the work of the power press. The semi-hard cakes are placed on the dial over the pockets, which are plainly shown between the round-head machine screws on the dial plate. The cakes are inclined to be a little irregular, and for this reason it is necessary to force them into the dial pockets; this is done by the punch at the left in the ram above. The die is located below the dial plate directly under the forming punch in the middle which, passing through the pockets, pushes the cakes into the die and exerts enough pressure on them to *condense the moisture, densify* the material, give each cake a uniform appearance, and at the same time *embosses* a suitable design.

After this operation the tendency of the cake is to stick in the die, and to overcome this the bottom of the die is removable. By means of the cam-actuated knockout shown to the left, below the dial-indexing mechanism, the bottom of the die is raised as the punch ascends and forces the formed cake back again into the dial pocket. The third punch, shown to the right, is set on an arm considerably in front of the center of the slide, and is used to push the finished cake through the pocket into a receptacle



MAKING PAINT TABLETS ON A PUNCH PRESS.

below the press bed to receive it. The dial feed is operated in the usual manner. The press will make sixty cakes per minute. The total weight of the machine, which has been built by the E. W. Bliss Co., Brooklyn. N. Y., is 800 pounds.

United States Judge J. V. Quarles granted an injunction in Milwaukee a few days ago against the iron molders' union, which injunction, we believe, goes a little further than any granted previously. It not only enjoins the molders from doing the things which they are usually enjoined from doing in the case of a strike, but it specifically prohibits them from visiting the homes of any of the employees of the Allis-Chalmers Company for the purpose of persuading them to leave the employment of said company.

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The Verein Deutscher Ingenieure Branch Engineering Societies.

All the engineering world is congratulating the Verein Deutscher Ingenieure upon its attainment to the dignity of 50 years; the celebration of the 50th anniversary of its organization having commenced in Berlin on the 10th of June. The society from a small beginning, which was initiated before the formation of the present German Empire, has grown to 20,000 members, one-fourth of whom reside in other countries. It has done much and very important research work; it has done much in the way of standardization, and along with other good work carried on by the society, it has been instrumental in taking the matter of boiler inspection out of the incompetent hands in which it had been placed, and putting it in the hands of engineers competent to do the work.

In many respects the Verein Deutscher Ingenieure will be found a worthy example for other engineering societies, but in one way its example is being referred to as a suitable one to follow here in America and wherein we do not believe it is practicable to do so. We refer to the fact that the Verein Deutscher Ingenieure has organized and maintained many local branches throughout Germany. This seems to work well there, apparently because there is in Germany only one association of engineers; the society referred to embracing within its members both civil and mechanical engineers, so that anyone who is an engineer in Germany, whether civil, mechanical, electrical, heating and ventilating, illuminating, testing or whatnot, and who belongs to an association there belongs to the Verein Deutscher Ingenieure, and if he be outside of Berlin may associate himself with one of the branches of this society. This enables engineers in a given locality to get together for the discussion of matters of mutual interest, and to promote acquaintanceship, which is probably the most valuable result of such organization.

It has been assumed because the German society is so successful with its branches that one or more of the American national engineering societies might do equally well. We believe that the experience of our Institute of Electrical Engineers with its branches has so far not tended to show that this is necessarily true, and on the other hand, it seems to have been pretty conclusively shown that the best local engineering societies in America are composed of all sorts of engineers living in the locality concerned, and who get together for the discussion of matters that interest them. This results in much stronger and better supported local societies than could possibly be the case if all the members of a local society had to belong to a given national society, or were divided along the lines of their membership in various national societies. At any rate the logic of events seems to be in the direction of local bodies composed of all sorts of engineers. There are those who seem to think that these various local bodies will some day unite or affiliate and form a national society of engineers. It may be so, but on the other hand it may not, and whether it turns out to be so or not, it seems doubtful if the formation of a number of local bodies in every manufacturing center, each of these bodies connected with a separate national society, would be a good way to overcome the difficulty.

There is now no reason for discussing the reasons why we have not in America one general engineering society subdivided into groups as may be necessary, nor is there any use in regretting that such is not the case, granting that it would have been better if it had been so, which is by no means proved; but, however this may be, there are reasons why local engineers of various kinds, such as civil, mechanical, and electrical, should be acquainted, should meet occasionally, and discuss things of mutual interest looking to their co-operation, which reasons do not apply to engineers scattered throughout the country, and who can meet only once or twice a year. These same engineers can then, with advantage, belong also to the national associations, which, when opportunity offers, bring them into contact with engineering work in their branches, broadly speaking. In Philadelphia, Pittsburg, Cleveland, and elsewhere, local organizations have been formed which have demonstrated the great advantage of such organizations, and which in our opinion are much better off than they possibly could be, did the members attempt to maintain any sort of a connection with any one of the national engineering societies.

Not only is our situation here thus shown to be essentially different from the situation in Germany, but in other respects—geographically, commercially, and otherwise, we are situated entirely different from our German friends, and while it is of course wise to take every point we can from the experience of others, we must after all work out our own problems in our own way, or it is quite certain there will never be any satisfactory solution of them.

It seems now probable that the use of the new United Engineering Building will bring various national societies more closely together, and will strengthen all of them, making membership in them much more valuable and desirable than it has been in the past. It seems likely also that this and other influences at work will lead to a considerable enlargement of the scope of these societies, and that membership in them will become from this time on increasingly useful and valuable, not only to members living near headquarters, but to all whose names appear upon the membership rolls.

For Better Roads.

The Geological and Natural History Survey of the State of Wisconsin has inaugurated an excellent work looking toward co-operation in the improvement of the highways of that State. It is making an investigation of the roads of Wisconsin and is putting itself in position to furnish to local officers in charge of the work of construction and maintenance of roads, reliable information as to where the best materials may be obtained in the neighborhood and the best methods of the construction of roads so as to get the best results from the money and time expended. Other States might imitate the example of the Geological and Natural History Survey of Wisconsin to great advantage. The development of commerce and manufacturing within a State depends very much upon the roads, and in nothing perhaps do the American people spend time and money with so little good result in proportion to the expenditure as in road building. We have some very good roads in New Jersey and some other parts of the more densely populated portions of the country, but our American roads generally are a handicap and disgrace to us and they probably will never be any better until there is some organized and systematic effort looking to their betterment, such as is proposed by the Geological and Natural History Survey of Wisconsin. A. O. Hotchkiss, geologist in charge of Economic Geology at Madison, Wisconsin, ought to receive every possible encouragement and support in his most important work.

We are a little afraid that about the only effect of the report of a committee of the National Association of Manufacturers, appointed to investigate the union stock yards and packing houses in Chicago, will be to injure the standing of the Association. People have quite generally made up their minds regarding the condition of affairs at the stock yards and in the packing houses, and this investigation made by a committee of the Association, after the packers have had abundance of opportunity to prepare for such investigation, and which investigation was advertised, not only in Chicago, but throughout the country by the press, some days before it was made, will have very little weight with most people, and we doubt if the Association has been organized for or ought to be conducted for any such purpose.

Engineers can be found on both sides of the tall chimney stacks vs. mechanical draft question. From the experience of the power stations around San Francisco, however, it appears that for countries subject to earthquakes mechanical draft has now a strong argument in its favor, since the majority of the tall stacks were wrecked.

New Tools and Machine Shop Appliances.

THE CUT INDICATOR.

The instrument shown in the illustration, known as the Cut Indicator, is devised to permit of rapidly ascertaining the rotary speed at which to set a machine in order to obtain any given cutting speed, thus facilitating the employment of the highest cutting speeds that the tool will stand; this is especially important where high-speed tool steels are employed. The instrument can be mounted directly upon the machine tool and used without removing it from its position. It consists of a strong highly polished nickel-plated case and cap. By removing the cap the dial is disclosed beneath the glass face. This dial consists of three scales, an inner and an outer movable one and an intermediate one which is fixed. The movable scales are rotated together by means of a small toothed wheel, which projects

THE CUT INDICATOR.

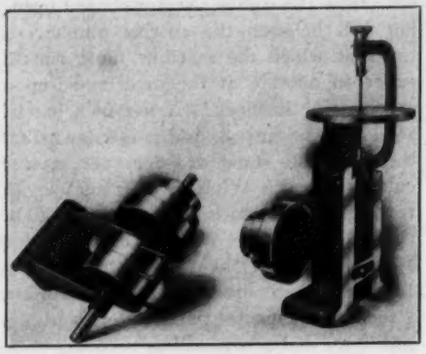
through the side of the case just enough to allow the finger or thumb to press on it and turn it. The inner movable dial, which is used for the diameter of the work, is graduated to read in inches from 1 to 1000 inches (or, if the cutting speeds also be divided by 10, this can be considered as from 1/10 to 100 inches), and the outer movable dial, only a part of which can be seen through a small sector-shaped opening, is graduated to read revolutions per minute, ranging from 1 to 1000. The fixed scale is graduated like the inner movable scale; it is used for the cutting speed and reads from 1 to 1000 feet per minute. Besides these scales there is a movable pointer which is moved by a projecting toothed wheel on the opposite side of the case to the first one. This pointer is merely a convenience for setting the dial and performs the same office as one might attempt to do with the finger tip or a scriber held in the hand.

In operation the pointer is set to the highest cutting speed the job will stand; then the diameter of the work (or tool, according to which revolves) is set to the pointer, and upon looking opposite the red arrow through the sector-shaped opening will be seen the correct number of turns at which the machine must run in order to operate at the determined-upon speed. For instance: A five-inch bar of steel is to be turned, and it is known that the tool will stand 260 feet per minute cutting speed. What is the number of revolutions at which the lathe should be run in order to get this maximum cutting speed? We set the pointer to the 260-feet-per-minute division and then set the 5-inch diameter to the pointer, and opposite the red arrow will be seen 199 revolutions, the required speed. Besides this the Cut Indicator can be used to find what cutting speed any piece of work is making at a known number of revolutions; simply set the number of revolutions opposite the red arrow, set the pointer to the diameter of the work, and opposite the pointer on the feet-per-minute scale will be seen the cutting speed. Among the applications of the Cut Indicator may be mentioned the finding of the number of revolutions a milling cutter should make to give its correct cutting speed, or when facing, parting or reducing to find the cutting diameter at which the lathe should be speeded up to its next step in order to keep it up to its maximum cutting speed. It is suitable for application to lathes, boring mills, thread millers, automatic machines, chucking machines, cutting-off machines, metal-cutting saws, turret lathes, tapping machines, threading dies, reamers, taps, etc. No acquaintance with mathematics is necessary for the operation of the instrument; but those familiar with the slide rule will recognize in it a special form of circular slide rule, which by one setting divides the cutting speed in feet by the diameter of the work in inches and multiplies the quotient by the constant $\frac{12}{\pi}$, though the user need not know that it does all this. The instrument is approximately 3½ inches in diameter and 1½ inches high. It is made by the Cut Indicator Company, 150 Nassau street, New York City.

FILING MACHINE.

The half-tone illustrates a machine designed for filing out irregularly-shaped dies, such as are used in watch, clock, jewelry and other work, and it may be used also for working out jigs, templets or gages of thin metal, and being adapted to use diamond laps as well as files, it is of service in finishing parts which are hardened. The table, which is 4½ inches in diameter, is carried on a graduated swivel, by which it can be set so that work may be filed at any required angle. The yoke provides a top support for the tool, so that very small files or saws for jig-sawing may be used, while larger files can be used by removing the yoke and using the bottom support only if desired. The

stroke is adjustable from ⅜ to 1¼ inch by means of a variable-throw crank-pin



FILING MACHINE.

block, driven direct from the cone pulley. This machine is made by B. C. Ames & Co., Waltham, Mass.

A HEAVY DRILL PRESS.

The accompanying photographs illustrate a drill press for use with high-speed drills from ½ to 1½ inches diameter. It has been designed to meet the demand for a powerful drill capable of running continuously at high speeds.

The enormous increase in production which can be secured by the use of high-speed drills is well known, but in order to use them successfully it is absolutely necessary to have a machine so rigid that it will not spring under the thrust caused by a heavy feed.

Rigidity has been secured by using the box column. The upper part of the column is 8 inches thick, which will give an idea of the proportions of the tool. The table is gibbed to the front of the machine, and is further supported by an elevating screw, capable of taking the entire thrust.

Driving power at high speeds is obtained by using wide belts and gearing. The design of the speed-changing device is such that very little power is lost in friction between the driving-belt and the spindle. There are no ratchet or friction drives on the machine; every drive is positive, with the exception of the intermediate belt which is wide, and will not slip under very severe loads, but will act as a safety before the gearing is damaged. The machine is capable of drilling 1½-inch holes in steel without the back gears.

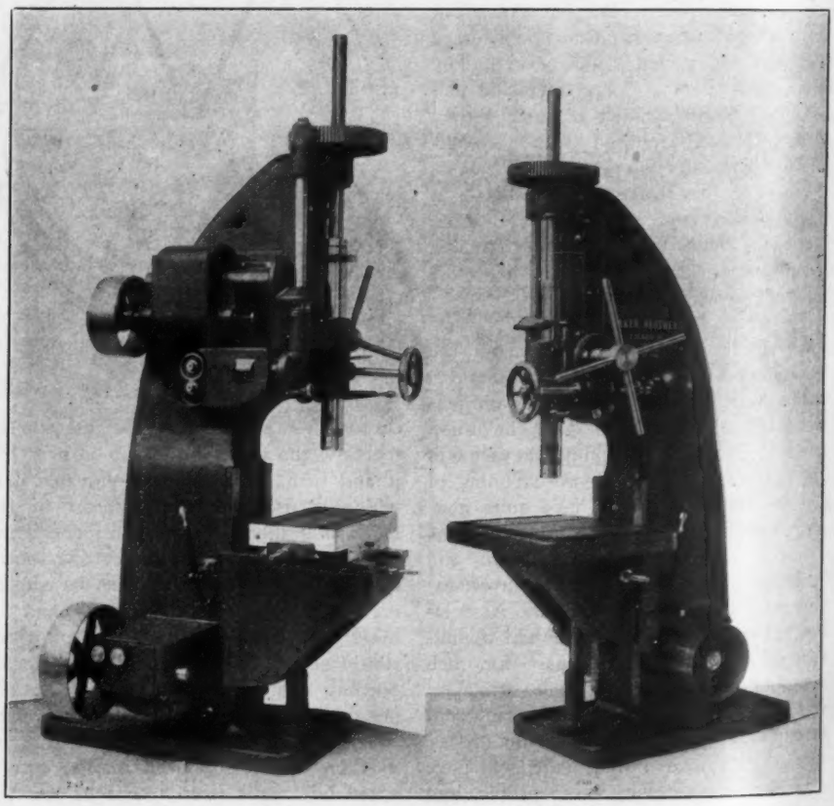
The speed-changes are obtained by sliding gears. The machine can be started or stopped from either side. The feed can be changed while the machine is running, the handle being convenient for the operator when standing in front of his machine. The changes from power feed to hand-worm feed or quick lever feed are all within convenient reach. The back-gears are thrown in or out by pushing or pulling a rod. When the compound table is used, work can be centered under the drill after it has been clamped to the table, and when so centered the table does not have to be locked in place, but will stay wherever set. While one piece is being drilled another may be chucked on the opposite end of the table.

The machine has eight speeds varying from 25 r.p.m. to 370 r.p.m., thus adapting it for use in shops where both carbon and high-speed drills are used, also enabling it to be used for boring. Positive-geared feed is provided, having three changes and provision for compounding these so that a wide range of feeds is possible.

The bearings are all bronze bushed and the shafts ground. The back-gears and change-speed gears run in a bath of oil. Tests of this machine have shown that it will drill a 1-inch hole in cast iron with a feed of 13½ inches a minute. The spindle is made of hammered high-carbon crucible steel 2 inches diameter at its smallest section, the socket at the end is Morse taper No. 4. The spindle has a travel of 16 inches. The bracket type of table, shown to the right, is 17x23 inches inside the oil grooves. The compound table, shown to the left, is 13x20 inches; it has a longitudinal travel of 18 inches and cross-travel of 10 inches. No countershaft is furnished or required as the machines belt direct to the line shaft. The machine weighs 3000 pounds. The floor space necessary with the plain table is 41½x 41½ inches and with the compound table 41½x53 inches. Suitable oil pump, tank and piping are supplied. Machines can be arranged to be driven by a 3½-h.p. motor when so desired. These machines are built by Baker Brothers, Toledo, Ohio.

PORTABLE ELECTRIC DRILLS.

The accompanying line engravings illustrate the principal features of the Duntley portable electric drills, which are built in three distinct types, each adapted to its own particular class of work, but all embodying practically the same mechanical features. These are known as the single-motor, two-motor and three-motor drills respectively. The single-motor drill is built in several sizes ranging from ⅜-inch capacity to 1¼-inch. For drills for holes larger than 1¼-inch if one armature is used it becomes quite large in diameter and the speed must necessarily be reduced to keep down the peripheral velocity. It is for this larger work that the two- and three-motor drills become desirable. By the use of two or three small armatures properly geared to the main driving spindle, greater power can be secured for a given weight on account of the higher speeds that the armatures can be run at with safety. Figs. 1 and 2 show sectional views and plan arrangement of armatures and fields of the two- and three-motor drills respectively.



A HEAVY DRILL PRESS.

Since the construction of these drills is somewhat analogous they will be described together: The magnetic field casing is a steel casting to which are bolted the drop-forged pole pieces. The armatures are of the slotted type, with coils of double silk-covered magnet wire secured in place by means of wedges. The commutators are built up of hard-drawn copper bars, insulated with amber mica, and the commutator sleeves are of machinery steel. The

shafts are of high-carbon steel, with the pinions formed integrally at the end, and are hardened and ground at the bearings. The bearings are of ball type, with provision for slight end play of the armature. Provision also is made for the application of lubricant to the gears, which are hardened. The brushes used are carbon. The outer casing is of non-magnetic material. The magnetic flux in each drill is in series through the armatures, thus insuring the same speed for all the armatures. The fields are compound wound and a very low starting current is required; at the same time a fairly close speed regulation is obtained. A special ventilating system is provided, which keeps a stream of cold air pouring through the winding at all times. A fan is placed on the upper or commutator end of each armature shaft and the air is drawn in here and forced out at the lower end.

The handles are of pipe located near the line of center of gravity of the drill and the flexible leading-in cable is passed through one of these handles. A quick-break switch is mounted in the drill housing at the base of one of the handles, and is protected from external injury. The switch cuts off all current entering the drills. A reversing switch is furnished when so ordered, and is arranged so that the drill cannot be reversed without first throwing off the current by pushing the "off" button on the switch.

The single-motor drills up to ½-inch capacity are shunt wound. The larger sizes are compound wound. The electrical construction, the cooling features, etc., are practically the same as in the two- and three-motor drills, and the planetary driving-gear arrangement is similar, but of course simpler, as there is but one driving pinion. The gears have a normal peripheral speed of about 475 feet per minute and in a drill capable of drilling 1¼-inch holes in iron or steel, the energy required to drive them up to this speed, free, is about 18 watts, or 1/40 of a mechanical horse-power. The total energy required by the drill running empty at full speed is 83 watts, or 1/9 horse-power, including all mechanical and electrical losses. The temperature rise of the drill after ten hours full-load service is stated not to exceed that of the surrounding air by more than 35 degrees C. or 63 degrees F. The maker states that with the larger drills of this type (single-motor) using a 1¼-inch drill 1 cubic inch of gray iron can be removed per minute. The two- and three-motor drills, which are adapted for drilling holes up to 2¼ inches in iron and steel, and for boiler plate reaming and tapping for staybolts are capable of removing 2¼ cubic inches of gray iron per minute. The manufacturer is the Chicago Pneumatic Tool Company, Chicago, Ill.

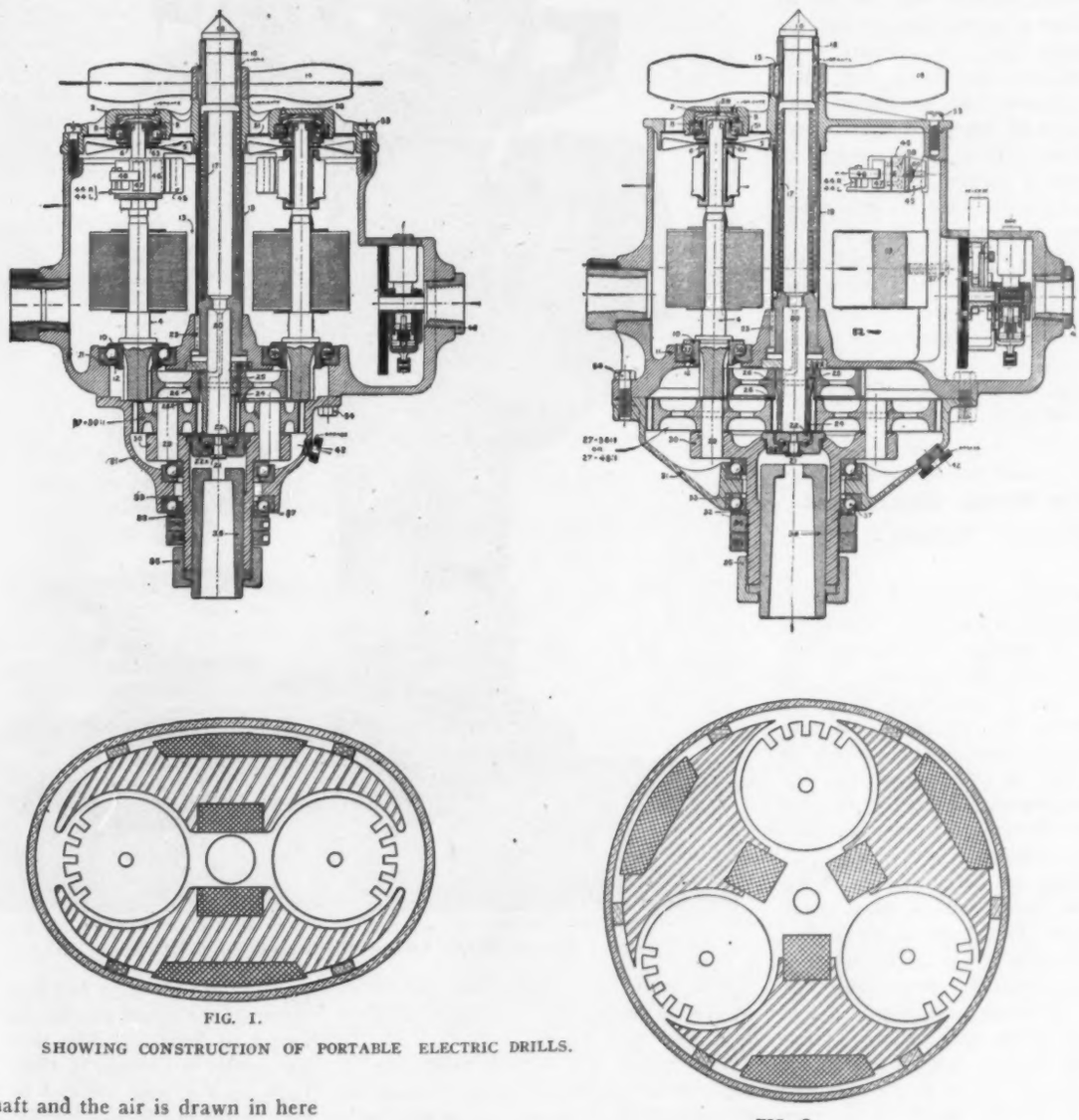


FIG. 1.

SHOWING CONSTRUCTION OF PORTABLE ELECTRIC DRILLS.

FIG. 2.

The 60-foot Terminal Lake Canal for Panama.

We have received from Lindon W. Bates an advance copy of an article by him for the *Journal* of the Franklin Institute, entitled, "The Terminal Lake Canal," also an account of the hearing before the Senate Committee of Interoceanic Canals, March 1906, upon the lock projects of the majority of the International

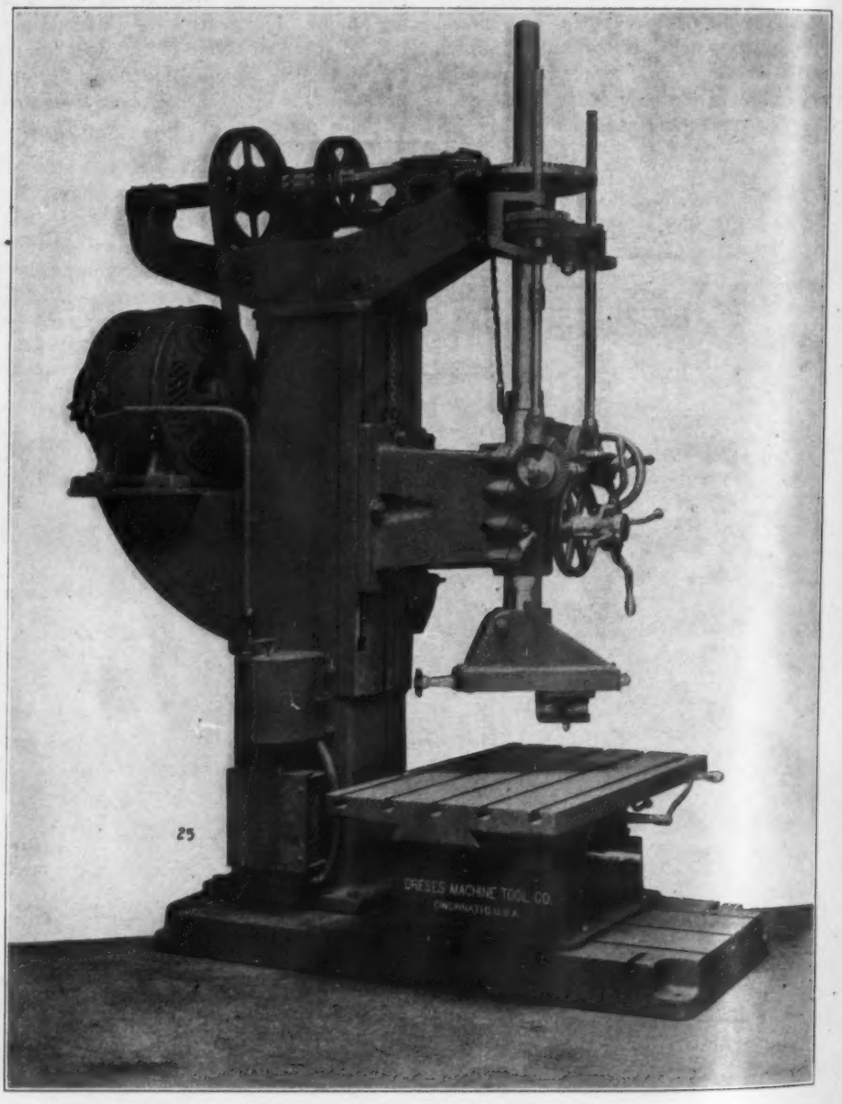
Board and Lindon W. Bates, together with criticisms upon the sea level and 85-foot 6-lock plan of the minority. The terminal lake canal with a summit level of 60 feet is the plan which Mr. Bates advocates as the proper solution of the Panama problem; it would contain three navigable lakes, no dam with over 36 feet net head, locks widely separated, never in flight; Chagres regulation by the empty basin system and Assouan-type dams.

Mr. Bates aims to show the superiority of the 60-foot level lock canal over the 85-foot level canal, and also presents arguments against the sea-level plan which the majority of the Senate Committee favored. In criticizing the former it is declared that the locks should have usable dimensions of 1000 feet by 1000 feet by 40 feet with room for extension; that no locks should be arranged in flight one above another, and that the 85 feet head of the proposed dam exceeds the safe percolation limit. As compared with the sea-level plan, the Bates plan offers 26½ miles of open lake navigation, with only nine miles of narrow channel where greatly reduced speed is necessary, as compared with a narrow passage the entire length of the proposed sea-level canal. Great savings in cost, time of completion and in loss of life are also claimed for the 60-foot level plan. Mr. Bates states that in one year by his plan, every swamp near the canal would be drowned in 25 feet of clean water and the work could be largely done by water-borne machines, thus avoiding the ravages of the disease-carrying mosquito.

A Heavy Boring, Facing and Tapping Machine.

This machine is intended for such drilling, boring, facing and tapping as is beyond the capacity of the ordinary upright and radial drill presses. It will conveniently handle such work as cutting holes in plates, bars, etc., that cannot by reason of their shape or size or both be swung on a boring mill of moderate size. The driving gearing is similar to that used in the ordinary drill press, but proportionately stronger.

The machine is driven by an 8-h.p. Westinghouse motor with a speed variation of 4 to 1. The power is transmitted by a Morse silent chain. The speed is regulated by a reversible drum controller. There are three gradations of geared feed for ordinary boring and drilling. These are arranged on the left-hand side of the spindle, those on the right are arranged by means of change gears to conform with the standard pipe threads. To avoid the irrational spacing of diametral pitch for the spindle rack it is cut ½ inch circumferential pitch so that a feed of one tooth is ½ inch. The change of gearing to pipe threads is made on the short stud next the right-hand feed rod. To disconnect the thread-cutting shaft the bevel gear next to the hand wheel is drawn out of mesh by a screw with a nurled head. The regular feed is engaged by a friction in front of the large bevel gear on the left-hand side. The feed can be changed while the machine is in motion by shifting the nurled collar on the left-hand feed rod. The spindle is provided with quick return. The headstock and spindle are counterbalanced, but to avoid accident when the tool on the spindle is too heavy a screw is provided for elevating.



A HEAVY BORING AND TAPPING MACHINE.

The table has longitudinal and cross movements as shown. The spindle socket is Morse taper No. 6.

The facing and boring head has a capacity of 22 inches. It is clamped on the spindle by a screw and driven by a key in the drift hole. There is also on the opposite side a taper spring plug engaging in a corresponding taper hole in the spindle socket. The tapping capacity of the machine is up to 10-inch pipe.

This machine is built by the Dreses Machine Tool Company, Cincinnati, Ohio.

All visitors to the Columbian Exposition will remember the 250-ft. Ferris wheel, for at that time there wasn't some kind of a whirligig in every street railway park and similar resort in the country, as subsequently became the case. This famous wheel was destroyed on May 11 by the St. Louis Exposition wreckers in order to save the expense of taking it down, as there seemed to be no further use for it. An effort was made to throw the wheel over on one side by the use of dynamite in the foundation, but the result was to drop it to the ground and it collapsed into a scrap heap about 30 feet high. The designer of the wheel was the late G. W. G. Ferris, of Pittsburg, who built it for the Exposition in Chicago in 1893. After the Exposition it was removed to a summer park resort in Chicago, but did not attract very much attention till it was removed again to St. Louis in 1903. The wheel consisted practically of two wheels, placed 28 ft. 6 in. apart, connected together, and carried by an axle of 33 in. diameter upon towers 137 ft. high. Its weight was about 4300 tons.

American Society for Testing Materials, Atlantic City Meeting.

(*Continued from page 844.*)

introducing steel pipe to take the place of wrought-iron pipe, cited instances to show that the notion that the iron pipe is superior is erroneous. He said finally that an effort was being made to make steel pipe so much superior to iron pipe that there would be no doubt about it and he believed this would soon be done, although he was not yet at liberty to give particulars.

On motion a committee was appointed to consider the matter and report.

HEAT TREATMENT OF STEEL.

Professor Howe, chairman of Committee F, on "Heat Treatment of Iron and Steel," gave an account of some experiments that had been conducted in which a muffle surrounding the specimen had been heated by radiation only, so that the specimen had been heated only by secondary radiation and was thus surely heated evenly. Gas had been used and Professor Howe said that might be thought strange in view of the use of the electric current for such purposes, but he said that at the high temperatures attained platinum loses its conductivity so rapidly that its cost becomes excessive and it is impracticable to use it.

Dr. William Campbell read a paper on "The Effect of Heat Treatment on High Carbon Steels," exhibiting a number of photographs showing the effects of varying temperatures and stating that a temperature of 760 degrees Centigrade seemed to give the best results, temperatures higher having the effect of breaking down the cementite into graphite.

There was a general discussion of the subject in which it was brought out that laboratory tests made with small pieces were often quite deceptive for the man who has large masses of steel to handle, and among other things it was positively stated by Mr. Christie and others that steel that had been overheated could be restored by careful reheating so long as the high temperature had not reached the point at which actual mechanical defects—cracks—appear.

FRIDAY AFTERNOON SESSIONS.

There were two separate meetings on Friday afternoon also, one dealing with iron and steel, the other with preservative coatings.

What is known as Committeee A presented a report which dealt chiefly with "Standard Specifications for Steel Rails" and in which it proposed to make certain changes relating to testing by blows and with regard to the part of the ingot to be discarded.

Just here the difficult character of the work undertaken by the society manifested itself, i.e., to constitute a court to which the user and his engineer, and the manufacturer as well, may resort to have differences reconciled and varying interests conserved. It appeared in the discussion that the committee had been for several years considering the matter. Serving upon it are an equal number of engineers and of representatives of manufacturers. It had been impossible to secure a full attendance at the committee meetings; the members of the committee differed among themselves, and engineers representing various railroads, comparing the society's specifications with those of other societies, said that unless the specifications were modified or made to accord more closely with others, the only effect would to be discredit the society.

The whole matter was referred back to the committee by a resolution containing what the chairman, W. R. Webster, strenuously objected to as unnecessarily harsh language, and repeatedly asked to have modified but without avail. He also evidently considered the reference to the committee useless, and asked for specific instructions as to what was to be done, in answer to which the meeting resolved to ask him to suggest what should be done.

SHIP MATERIAL.

There was a discussion on "Standard Specifications for Ship Material," which was opened by E. P. Stratton and W. R. Webster, who were almost immediately saying things that they did not "want to go on the record."

Mr. Stratton expressed himself as being for "America for Americans," and seemed to have a poor opinion of what has been referred to by another patriot as "abroad." His resentment was aroused by Mr. Webster's quotation from the specifications of Lloyds Register, and in the course of his remarks he said that when the American Line steamers "St. Louis" and "St. Paul" were to be built at Cramps it was made to appear by certain Britishers that it would be desirable to have the material inspected, and passed in accordance with Lloyds rules. This was done by arrangement with the Hunt Testing Laboratories of Pittsburg. Afterward American material went to Britain for use there in making ships, after having been inspected by the same laboratories. Upon arrival it was rejected by Lloyds and thrown into the scrap.

Mr. Webster said that was only because the testing laboratory mentioned was not authorized to represent Lloyds, and the plates had not been tested in varying thicknesses, and declared that it was exceedingly unfair to speak of the matter in the way Mr. Stratton had done.

FIRE-BOX STEEL.

Max H. Wickhorst then read a paper in which he gave details of many tests made by himself, to show the conditions to which fire-box sheets of locomotive boilers are subjected. He had taken many temperature observations, particularly in connection with feeding cold water, and his general conclusions were that long life of fire-box steel is to be secured by suitable treatment of the feed-water—generally by plain soda ash to destroy sulphate of calcium; by avoiding sudden changes of temperature due to cold feed-water being allowed to drop to the bottom of the boiler at a time when active steaming is arrested; by keeping the boiler continuously hot and by suitable arrangements for blowing out.

At the conclusion the author was asked with regard to low sulphur specifications whether there was any appreciable difference between sulphur 0.03 and sulphur 0.035. He could not say that there was. Another member asked the meeting generally whether or not any failure of a fire-box sheet had ever been traced to sulphur. Apparently no one could say that it had been.

SEGREGATION.

C. L. Huston, vice-president of a steel and iron company, then presented a paper upon "Experiments on the Segregation of Steel Ingots in its Relation to Plate Specifications" and threw upon the screen a number of photographs of ingots that had been planed off to the center of their thickness in such a way as to show the lines of faults or blow holes formed by the failure of the gases to escape during the process of congelation. He said that whereas he had formerly believed that these holes did not close up solid in the process of rolling, he now believed they did and that a plate rolled properly would show no evil effects from them. He also showed figures for a number of tests of ingots in which specimens for physical and chemical testing had been taken from every part of the ingot; showing that the results were concordant.

He objected, on the strength of the results shown, to the present requirements that test specimens shall be taken from diagonally opposite corners of the ingot and said that he believed much steel was going into boilers and other structures which steel was entirely too hard to be safe because as shown by his tests the hardest material would usually be found elsewhere than in those portions of the ingot from which the test specimens were taken.

Mr Webster thought that cold bending tests would abundantly provide against that danger.

Before adjournment Secretary Marburg threw upon the screen a cartoon showing Committee A as it would look in 1956, with its problems still unsolved and the discussion still going on. It was much appreciated by most of the audience.

SATURDAY MORNING'S SESSION.

The first business of any special interest at this session was the report given by Dr. Richard Moldenke, secretary of Committee J, "On Standard Specifications for Foundry Coke." The speaker asked that the title of the committee be changed by striking out the word Foun-

dry, it having seemed advisable that all kinds of coke used for industrial purposes should be investigated. A good many samples of coke had been tested, and it had been found that, owing to the very bad coke which had to be put up with during the recent coal strike, by-product coke had been used in many cases and in some of these had stuck and continued to be used. Tests had shown that in some cases at least this by-product coke had produced just as good iron as could be produced by any other coke, and it needed only that users of coke should be educated out of their habit of judging coke by general appearance and by fracture, and taught that it is possible for a coke to be very good for actual use, when its appearance seemed very much against it. It was stated that out of 5500 foundries only about 500 of them know much about what they are doing with their coke. The problem is to educate the other 5000. A member connected with the government tests of fuels now going on said that so far they had experimented with bee-hive oven cokes only, but that they would take up by-product cokes later. Out of 152 tests so far made, 90 per cent. of the coals made coke, though some of them that coked had been considered non-coking. It was believed that mixing different coals would sometimes enable coke to be made from non-coking coals, and also that some of it could be coked by adding volatile hydrocarbons.

SPEED OF TESTING.

The committee on "Uniform Speed in Commercial Testing," reported through Paul Kreuzpointner, chairman, who had gathered a large number of samples, and had them tested at various laboratories throughout the country. The general conclusion seemed to be that for commercial testing the determination of the elastic limit and the yield point was impracticable, and that if these were not determined, and only the ultimate strength was to be considered, the higher speeds that had been in use in pulling tests up to 4 or 6 inches per minute were practically as good as the slower speeds. In the discussion it was evident that some of the members did not distinguish between the elastic limit and the yield point and attached little importance to either; others, however, did, and pointed out that the slow speeds required for the determination of the yield point need not be continued for but a short time at the beginning of the test, and after this was determined the speed could be raised to the maximum for the balance of the test. The line between those who thought commercial testing could not take account of the yield point and those who thought it could and ought to do so, was sharply drawn, Professor Marburg favoring it, and Professor Merriman declaring it to be dangerous to ignore it. He proposed that autographic apparatus ought to be used for indicating the yield point, and that such apparatus ought to be devised that would work at the high speed demanded. He was answered that such apparatus has been devised, and was used, but that it took too much time to attach it to the specimen.

On motion it was recommended that "standard" speeds be specified for testing machines.

Committee T through its chairman, J. A. Kinkead, reported on tests of springs, chiefly locomotive springs, setting forth the varying practice of different makers and spring users in specifying and testing, and presenting diagrams illustrating the differences shown by springs with increasing and decreasing loads. The surging test has, it seems, been abandoned by the makers as being too slow. The test used is not as good and tells much less about what the spring will do in actual service, but has to answer.

SATURDAY AFTERNOON.

This session was devoted largely to water-proofing, regarding which diametrically opposite opinions were expressed by different men apparently equally well qualified to express an opinion, the general result being to the effect that it was very important but nearly impossible.

Professor Lanza, chairman of the committee on "Standard Methods of Testing," made a brief report, after which W. C. DuComb, Jr., gave an account of two large testing machines built by Riehlè Bros., and which were described and illustrated in these columns not long since. The speaker said that in testing the larger of these machines it was loaded to its full capacity, 600,000 lb., and that when so loaded it had correctly indicated an additional weight of 142 lb. placed upon the platform. He was not sure that could be repeated and thought it might have been a coincident, but the fact remained that it had been done.

Personal.

George I. Rockwood has been appointed to the chair of Professor of Steam Engineering in the Worcester Polytechnic Institute.

F. M. Briggs, formerly with the Fairbanks-Morse Co., is now superintendent for the Aetna Foundry & Machine Co., Springfield, Illinois.

W. H. Whiteside, president of the Allis-Chalmers Company, accompanied by Mrs. Whiteside and daughter, sailed for Europe for a recreation trip June 19.

Herman Fletcher, of Louisville, Ky., sends us photographs of James Watt and Matthew Bolton, and in connection with them states that the original steel engravings from which the photographs were made were given to his grandfather; the one by James Watt and the other by James Bolton. The original engravings have been in Mr. Fletcher's family for 106 years. His grandfather started the first engine that came out of Bolton and Watt's shop at London, England.

Obituary.

Charles Eastman Tripler, inventor of liquid air, died June 20, of Bright's disease, at Liberty, N. Y., after an illness of several months. He was born in New York city in 1849, and while attending school showed an aptitude for mechanics and chemistry. When he was 23 years old he constructed a naphtha condensing engine and then devoted himself for several years to experimenting with chemicals. He discovered a method of liquefying air in 1890.

Heinrich Sulzer-Steiner, head of the famous firm of Sulzer Brothers, of Winterthur, Switzerland, died at Berne, May 11, aged 69 years. He was born in an old dwelling house adjoining the Sulzer works, three years after the establishment of the firm by his father, Johan Jakob Sulzer, and as a boy attended the local schools, going later to the Polytechnikum at Karlsruhe. Upon finishing his course there he went to England, and on returning to his native land, in 1860, was taken into partnership in the firm. In 1872 he became the head of the establishment, which had by this time become a very prominent engine-building concern. Aside from directing the works, which under his administration grew from a plant employing a few hundred men to one having nearly 5000 employees, he took a special interest in the welfare of his workmen and was the founder and a member of council of numerous Swiss associations. In 1900 he received the Grashof medal from the Verein Deutscher Ingenieure, and he was appointed honorary Doctor of Engineering by the Karlsruhe Technical High School.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Good tool or machine specialty wanted. Give full particulars. Automatic, 660, AM. M

Light and fine machinery to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—Work for an 84-inch Bickford boring mill; can furnish castings. Fulton Machine & Vise Co., Lowville, N. Y.

Wanted—To complete volume, AMERICAN MACHINIST of April 13, 1905. Will pay premium. Box 613, AMERICAN MACHINIST.

Punch press wanted. Bed opening about 22 in. Also No. 1 Universal miller. E. B. Abbott, 2912 Central avenue, S. E., Cleveland, Ohio.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear and Machine Co., 141 Oxford street, Philadelphia, Pa.

Wanted—Worms, spirals and screws to cut. We are equipped with special machines for milling these parts. Get our prices on doing some of your difficult jobs. Parsons & Lane, Sodus, N. Y.

Specialties—We make on contract, specialties for marine, automobile and general use, and do general machine-shop work on small brass goods. Lovell-McConnell Mfg. Co., Currier Bldg., opp. Pennsylvania Railroad Station, Newark, N. J.

A manufacturing concern having one of the most modern and complete plants in Ohio for the manufacture of brass and iron specialties, including steam goods, solicits orders for special work in quantity lots. Address N. L. H., 172 West Locust street, Columbus, Ohio.

We build special machinery, tools, etc., for responsible parties at prices which will demonstrate our modern practice and facilities. Estimates gratis. Send drawing for our lowest bid. New Haven Tool and Machine Specialty Co., 456 Broad st., Bridgeport, Conn.

Tool catalog No. 22, 950 pages bound in cloth. Greatest small-tool catalog ever published. Will be sent post-paid on receipt of $1. Money paid for catalog refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton street, New York City.

Wanted—Agents in every State to handle exclusive territory on the Cone Gas Generator, which generates coal gas for stationary engines from 25 h.p. up, reducing the cost to 1/5 that of steam power; agents must be conversant with machinery business and devote entire time to the work. Cone Gas Machine Co., 1036 Majestic Building, Detroit, Mich.

For Sale.

For Sale—Excellent machine-shop building, with power, in Philadelphia; 60x90 feet, three stories, solid ground floor. Box 545, AM. M.

For Sale—One Ludw. Loewe & Co. 20-ton hydraulic press; never been used; can be seen at Smith & Wesson's, Springfield, Mass.

For Sale—One Gisholt turret machine, 24-inch swing, with counter shaft, boring bars and tools. In first-class condition. The Hobart Electric Mfg. Co., Troy, Ohio.

For Sale—Machinery-manufacturing plant, including machinery, tools, jigs and good will. Doing a business of from $100,000 to $150,000 per year; can secure buildings with water power at very reasonable rent for term of years. Address J., Box 678, AMER. MACH.

For Sale—Controlling interest in foundry and machine shop in thriving city of middle West. Only foundry in neighborhood; minority partners are practical foundrymen and willing to retain interest. Owner has business elsewhere requiring attention. $5000 in cash required. Address Box 162, Mt. Carmel, Ill.

For Sale—Complete electroplating outfit, including one 500-ampere dynamo, one 5 and one 10-horse-power motor, 500-volt direct-current, two cedar and three iron tanks, together with nickel, brass, bronze and copper anodes, rheostats, switches, grinding and polishing lathes, carborundum, bull neck, canvas, felt and cotton wheels, power press, wood pulleys, shafting, hangers, belting and supplies. Jim Bowstead, Room 6, New Kiley Block, Marion, Indiana.

Business Opportunities.

Wanted—An enterprising established firm with shops or shop connections to market a new and much improved design of a standard machine in large and constant demand. Address "Pitt," AMERICAN MACHINIST.

Wanted—Bid on some light manufacturing work, Eastern firm preferred; must be one who can guarantee delivery requiring at least five to ten men constantly working on contracts. Box 732, AMERICAN MACHINIST.

For Rent—Three-story brick and stone factory building with large brick manager's house and horse barn on grounds. Factory equipped with two 20 h.p. Smith turbine water wheels, two 11½ kw. Westinghouse D. C. generators. Fire protection on each floor. The most beautiful and healthful town in Pennsylvania. Cheap help—no manufacturing competition. Good railway and trolley facilities. Equipments all new, never used. Apply to T. A. Willson, Ephrata, Lancaster Co., Pa.

Wants.

Situations and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Engineer (English) seeks responsible position; 11 years' experience in H. M. Royal Navy; have had charge of erecting steam, electric and air-compressing machinery. Box 698, AMERICAN MACHINIST.

CONNECTICUT.

Position wanted by an experienced mechanic who can build special, new, improved machinery for valve manufacturing, and who is an expert in dies, fixtures, etc. Address P. O. Box 95, Bridgeport, Conn.

Wanted—Position as foreman of tool room or model room; 15 years' experience on tool work and designing medium and small tools, adding machines and typewriter work. For references write Box 758, AMER. MACHINIST.

Technical graduate, successful designer of automatic machinery, well up in manufacturing typesetter, typewriter and dental supplies; six years shop, 10 years drawing board, 34 years of age, desires position as assistant superintendent, $2000. Box 737, AM. MACH.

ILLINOIS.

Young, hustling mechanic, technically educated, practical experience, good executive, familiar with modern methods, has responsible position with large manufacturing company, desires change; any location. Box 749, AMERICAN MACHINIST.

INDIANA.

Position as superintendent or general foreman; wide experience in both capacities; high executive ability; clever designer of jigs and special tools; good handler of men; progressive methods for getting results; successful shop organizer and harmonizer; best of references by past and present employers. Box 751, AMERICAN MACHINIST.

MARYLAND

Mechanical engineer (employed at present), technical graduate, 10 years' experience in marine, automobile and general machine construction, desires position as engineer or assistant with contractor, consulting engineer or manufacturing company. Box 760, AM. M.

MASSACHUSETTS.

Mechanical draftsman, experienced toolmaker, designer of jigs, fixtures, automatic and special machinery, desires responsible position. Box 741, AMERICAN MACHINIST.

Skilled designer wants work; 12 years' experience in the shop building experimental machinery, 10 years designing. Hand operations made automatic. Have had experience in wood, metal and textile machinery. Box 721, AMERICAN MACHINIST.

NEW HAMPSHIRE.

Young American, varied machine-shop experience, at present foreman, is open for office, road or executive position; good education and a hustler. Box 742, AM. MACH.

Expert operator of B. & S. and Gould & Eberhardt gear cutters desires change. Box 735, AMERICAN MACHINIST.

NEW JERSEY.

Engineer desires change; where now employed has charge of drafting room, shops, power plant, construction and maintenance and purchasing department; thorough practical training in all branches. Box 689, AM. M.

Superintendent or general foreman of brass shop manufacturing steamfitters' and plumbers' supplies, experienced in handling men, system, up-to-date tools; references supplied. Box 759, AMERICAN MACHINIST.

Graduated mechanical engineer, 12 years' American and European practical experience, splendid connection, wishes position, July 1, as salesman, eventually represent firm abroad. Box 753, AMERICAN MACHINIST.

Machinist and toolmaker, German, 32 years, 15 years' experience all-around mechanic, building automatic machinery, jig tools and experimental work, steady worker, wishes to change; New York City and vicinity. Box 747, AMERICAN MACHINIST.

NEW YORK.

Wanted—Position as office manager or salesman; 15 years' experience in machinery line. Box 758, AMERICAN MACHINIST.

Mechanical draftsman, three years' experience, also shop experience, desires position in vicinity of New York City. Box 750, AM. M.

Mechanical engineer, technical graduate, 16 years' experience on machine tools, electrical machinery and gun work, desires change, Box 734, AMERICAN MACHINIST.

Foreman or assistant mechanical draftsman, technical graduate, five years' shop experience, desires position in New York or vicinity. Box 757, AMERICAN MACHINIST.

Foreman—Practical toolmaker, successful in producing first-class interchangeable work with unskilled help; past three years connected with large concern manufacturing meters. Box 752, AMERICAN MACHINIST.

Practical and technical educated mechanical engineer, 12 years' wide experience in designing and use of tools, fixtures and machinery for rapid production, wishes to change. Box 733, AMERICAN MACHINIST.

Wanted—Position in publicity department of manufacturing establishment in Eastern territory; experienced in the preparation of copy and with the details of cut making and printing. Box 681, AMERICAN MACHINIST.

Works manager or superintendent; machinist; technical graduate; general manufacturing experience. Successful methods in production and costs. Executive ability and energy. Good organizer; understand how to get results; age 31, married. Present position, superintendent of works. Box 717, AMERICAN MACHINIST.

Superintendent — Experienced in design, manufacture, erection and operation of machinery; recent work with electrical conveying and hoisting machinery; experience also with development and economic manufacture of small electrical and mechanical appliances —desires position where some of these qualifications would be of value; best references. Box 754, AMERICAN MACHINIST.

OHIO.

Situation wanted by experienced machine-tool salesman, with 7 years' experience; desirous of making change. Box 755, AM. M.

PENNSYLVANIA.

Technical graduate, American, 27, seven years designing automatic and machine tools, seeks better position. Box 736, AM. MACH.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—Foreman for toolroom in an automobile factory in Canada; must be an A-1 man, thoroughly accustomed to the most modern toolroom practices, accustomed to handling men, and one who is generally systematic in his work; permanent position to right man. In applying, please give experience, references and salary expected. Box 740, AM. M.

CONNECTICUT.

Wanted—Several competent all-around jobbing machinists. The Eastern Machinery Co., New Haven, Conn.

Wanted—A-1 machinist for constructing delicate apparatus; also young, energetic machinist foreman. Good opportunity for the right man. Box 711, AMERICAN MACH.

DISTRICT OF COLUMBIA.

Wanted—Master shipfitter (outside), $6 per diem. A competitive examination will be held for the above position July 12, 1906. For further information address Commandant, Navy Yard, Portsmouth, N. H.

ILLINOIS.

Wanted, draftsmen—We want capable draftsmen of either electrical, mechanical or general experience. If you would like to change your position or its location, write and tell us about the character and extent of your work. Address, giving full particulars, to Western Electric Company, Dept. N. 29, Chicago.

INDIANA.

Wanted—Foreman for die-sinking and drop-forge work, experienced in both lines; give age, references, etc. Address "Automobile," Box 756, AMERICAN MACHINIST.

IOWA.

Wanted—Draftsman who is familiar with structural iron and building work. Box 739, AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—One toolmaker, three machinists on auto work, and expert gear-cutting man. Box 738, AMERICAN MACHINIST.

Wanted—First-class machinist, who has also some experience in steam fitting, to learn to install air-compressors, etc., on lightships; must be proof against seasickness. Apply to Submarine Signal Co., 247 Atlantic avenue, Boston, Mass.

MICHIGAN.

Machine-shop Foreman—Wanted a competent machinist to take charge of the die and tool-making department of a large factory; applicants must show actual experience as foreman and must have a thorough knowledge of die designing and drafting. Address Box 744, AMERICAN MACHINIST.

MINNESOTA.

Wanted — First-class machinists, moulders and patternmakers, also structural template makers and structural iron workers. We are daily increasing our business and will consider applications from competent mechanics in the above branches of our business. Address, with references, Minneapolis Steel and Machinery Co., Minneapolis, Minn.

NEW JERSEY.

Wanted—Mechanical electrical draftsmen; only first-class men need apply. Box 508, AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work to good men. Address or apply at Pond Machine Tool Co., Plainfield, N J.

Wanted—At once a competent designer on jigs and fixtures and special machinery to take charge of drawing room. Apply with copies of references and state experience, age and nationality and salary expected. P. O. Box 214, Newark, N. J.

Wanted—Working foreman for grinding and polishing department, modern up-to-date plant located Newark, N. J. Must be familiar with standard makes of universal machines and capable of getting work out cheaply and accurately. Box 745, AMERICAN MACHINIST.

NEW YORK.

Draftsmen wanted for jig and fixture work. Apply Mergenthaler Linotype Company, 20-42 Ryerson street, Brooklyn.

Wanted — Experienced draftsmen, toolmakers and machinists. Give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

Wanted—First-class men as toolmakers on punches and dies, also light high-grade jig and fixture work. Remington Typewriter Factory, Ilion, N. Y.

Diemaker and machinist to make dies and run automatic machines in a factory making builders' hardware. Apply to The Atlantic Co., 109 South Fifth St., Brooklyn, N. Y.

Wanted—First-class foreman for machine shop; must be able to handle men and produce work, also fairly versed in modern shop practice; give references. Address P. O. Box 73, Buffalo, N. Y.

Wanted—Toolmaker for responsible position in New York City. Excellent opportunity for a young married man. Only letters containing full particulars, expectations and references considered. Address Box 716, AM. M.

We are permanently increasing our capacity and require the services of 10 mechanical draftsmen for detail work; attractive positions to suitable men; location, New York City. Address, stating age, experience and salary expected, Box 748, AM. MACHINIST.

Wanted—A first-class machinist to take charge of a room for experimental work on new machines; must be a good general workman and have originality and ideas to assist in developing new designs, etc.; state experience, etc., also wages expected. Address H. J. K., 329 Frank St., Rochester, N. Y.

OHIO.

Wanted—High-grade machinist for engine work. S. M. Jones Company, Toledo, Ohio.

Several diesinkers, toolmakers and machinists. The P. A. Geier Co., 50 High St., Cleveland, O.

Several first-class draftsmen on detail and assembly drawings; state age, experience and salary. Box 746, AMERICAN MACHINIST.

Three or four competent mechanical draftsmen. In replying, give full information, including rate expected. Box 686, AM. MACH.

Our growing business constantly requires additional machinists. We build lathes, planers, shapers, drilling machines; good opportunity for machinists. The American Tool Works Co., Cincinnati.

Good draftsmen with experience in designing, by a machine tool concern in Cincinnati. One familiar with radial drills and screw and turret machinery preferred. Excellent future. State age, salary, experience and address Box 23, Sta. B, Cincinnati, O.

The National Metal Trades Association can place a few first-class wood patternmakers, toolmakers and all-around machinists. Highest wages and steady employment guaranteed. Address, with references, Robert Wuest, Secretary, 1416 Union Trust Bdg., Cincinnati, O.

PENNSYLVANIA.

Wanted—Thoroughly experienced erecting machinists, accustomed to steam engine or compressor work. The Blaisdell Machinery Co., Bradford, Pa.

Wanted—Designer and draftsman, technical education, for leading position; man experienced on hoisting-engine work preferred. Box 743, AMERICAN MACHINIST.

Wanted—A few first-class machinists and toolmakers; also one or two automatic screw-machine operators for automobile work; steady work guaranteed. Address, giving experience, references and wages desired, The Autocar Company, Ardmore, Pa.

Wanted—A first-class man as general foreman of our brass department on brass globe, angle and gate valves, and a general line of steam goods. Factory located in western Pennsylvania. To the right party we have a good position to offer. State age and experience. Address Box 692, AMER. MACHINIST.

The Monotype Company maintains a free school for training young machinists to operate its type casting and composing machines. The demand for monotype operators is so great that it receives more applications for places in its school than can be filled. In making selections these qualifications carry most weight: Character, common sense, experience with automatic machinery (or) printing-office experience, or type-foundry experience. Full particulars will be furnished to inquirers who furnish full particulars about themselves. Lanston Monotype Machine Co., 1231 Callowhill St., Philadelphia, Pa.

RHODE ISLAND.

Toolmakers wanted — First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Pierce Mfg. Co., Woonsocket, R. I.

WISCONSIN.

As the result of doubling its new West Allis plant, Allis-Chalmers Co., of Milwaukee, needs more patternmakers, machinists and moulders.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

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MICHIGAN.

Machine-shop Foreman—Wanted a competent machinist to take charge of the die and tool-making department of a large factory; applicants must show actual experience as foreman and must have a thorough knowledge of die designing and drafting. Address Box 744, AMERICAN MACHINIST.

MINNESOTA.

Wanted — First-class machinists, moulders and patternmakers, also structural template makers and structural iron workers. We are daily increasing our business and will consider applications from competent mechanics in the above branches of our business. Address, with references, Minneapolis Steel and Machinery Co., Minneapolis, Minn.

NEW JERSEY.

Wanted—Mechanical electrical draftsmen; only first-class men need apply. Box 508, AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work to good men. Address or apply at Pond Machine Tool Co., Plainfield, N J.

Wanted—At once a competent designer on jigs and fixtures and special machinery to take charge of drawing room. Apply with copies of references and state experience, age and nationality and salary expected. P. O. Box 214, Newark, N. J.

Wanted—Working foreman for grinding and polishing department, modern up-to-date plant located Newark, N. J. Must be familiar with standard makes of universal machines and capable of getting work out cheaply and accurately. Box 745, AMERICAN MACHINIST.

NEW YORK.

Draftsmen wanted for jig and fixture work. Apply Mergenthaler Linotype Company, 20-42 Ryerson street, Brooklyn.

Wanted — Experienced draftsmen, toolmakers and machinists. Give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

Wanted—First-class men as toolmakers on punches and dies, also light high-grade jig and fixture work. Remington Typewriter Factory, Ilion, N. Y.

Diemaker and machinist to make dies and run automatic machines in a factory making builders' hardware. Apply to The Atlantic Co., 109 South Fifth St., Brooklyn, N. Y.

Wanted—First-class foreman for machine shop; must be able to handle men and produce work, also fairly versed in modern shop practice; give references. Address P. O. Box 73, Buffalo, N. Y.

Wanted—Toolmaker for responsible position in New York City. Excellent opportunity for a young married man. Only letters containing full particulars, expectations and references considered. Address Box 716, AM. M.

We are permanently increasing our capacity and require the services of 10 mechanical draftsmen for detail work; attractive positions to suitable men; location, New York City. Address, stating age, experience and salary expected, Box 748, AM. MACHINIST.

Wanted—A first-class machinist to take charge of a room for experimental work on new machines; must be a good general workman and have originality and ideas to assist in developing new designs, etc.; state experience, etc., also wages expected. Address H. J. K., 329 Frank St., Rochester, N. Y.

OHIO.

Wanted—High-grade machinist for engine work. S. M. Jones Company, Toledo, Ohio.

Several diesinkers, toolmakers and machinists. The P. A. Geier Co., 50 High St., Cleveland, O.

Several first-class draftsmen on detail and assembly drawings; state age, experience and salary. Box 746, AMERICAN MACHINIST.

Three or four competent mechanical draftsmen. In replying, give full information, including rate expected. Box 686, AM. MACH.

Our growing business constantly requires additional machinists. We build lathes, planers, shapers, drilling machines; good opportunity for machinists. The American Tool Works Co., Cincinnati.

Good draftsmen with experience in designing, by a machine tool concern in Cincinnati. One familiar with radial drills and screw and turret machinery preferred. Excellent future. State age, salary, experience and address Box 23, Sta. B, Cincinnati, O.

The National Metal Trades Association can place a few first-class wood patternmakers, toolmakers and all-around machinists. Highest wages and steady employment guaranteed. Address, with references, Robert Wuest, Secretary, 1416 Union Trust Bdg., Cincinnati, O.

PENNSYLVANIA.

Wanted—Thoroughly experienced erecting machinists, accustomed to steam engine or compressor work. The Blaisdell Machinery Co., Bradford, Pa.

Wanted—Designer and draftsman, technical education, for leading position; man experienced on hoisting-engine work preferred. Box 743, AMERICAN MACHINIST.

Wanted—A few first-class machinists and toolmakers; also one or two automatic screw-machine operators for automobile work; steady work guaranteed. Address, giving experience, references and wages desired, The Autocar Company, Ardmore, Pa.

Wanted—A first-class man as general foreman of our brass department on brass globe, angle and gate valves, and a general line of steam goods. Factory located in western Pennsylvania. To the right party we have a good position to offer. State age and experience. Address Box 692, AMER. MACHINIST.

The Monotype Company maintains a free school for training young machinists to operate its type casting and composing machines. The demand for monotype operators is so great that it receives more applications for places in its school than can be filled. In making selections these qualifications carry most weight: Character, common sense, experience with automatic machinery (or) printing-office experience, or type-foundry experience. Full particulars will be furnished to inquirers who furnish full particulars about themselves. Lanston Monotype Machine Co., 1231 Callowhill St., Philadelphia, Pa.

RHODE ISLAND.

Toolmakers wanted — First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Pierce Mfg. Co., Woonsocket, R. I.

WISCONSIN.

As the result of doubling its new West Allis plant, Allis-Chalmers Co., of Milwaukee, needs more patternmakers, machinists and moulders.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

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Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Works, Boston, Mass.

Carborundum
See Grinding Wheels.

Castings, Brass and Bronze
Lumen Bearing Co., Buffalo, N. Y.
Nolte Brass Co., Springfield, Ohio.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.
U. S. Foundry & Sales Co., South Norwalk, Conn.

Castings, Motor
Brush & Hudson, Brooklyn, N. Y.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mahine Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link-Belt Engr. Co., Phila., Pa.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines
American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Westcott Chuck Co., Oneida, N. Y.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co.,, Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.

Chucks, Split
Hardinge Bros., Chicago, Ill.
Rivett Lathe Mfg. Co., Boston, Mass.
Westcott Chuck Co., Oneida, N. Y.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.
Switchboard Equipment Co., Bethlehem, Pa.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps
Billings & Spencer Co., Hartford, Conn.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V. Phila., Pa.
Double Friction Coil Clutch Co., Chicago, Ill.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., N. Y.
Reeves Pulley Co., Columbus, Ind.
Wood's Sons Co., T. B., Chambersburg, Pa.

Coal Handling Machinery
Link-Belt Engineering Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleve., O.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass
Bury Compressor Co., Erie, Pa.
Curtis & Co., Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Mietz, August, New York.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas
Ingersoll-Rand Co., New York.

Condensers
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.

Conduit, Interior
Sprague Elec. Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.

Controllers and Starters, Electric Motor
Case Mfg. Co., Columbus, Ohio.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Coping Machines
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Cork Inserts
National Brake & Clutch Co., Boston, Mass.

Correspondence Schools
See Schools, Correspondence.

Cost Systems
Wright, Harold A.; New York.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Morse Twist Drill & Mach Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.

Counters, Machinery
Durbrow & Hearne Mfg. Co., New York.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplers, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, Ohio.
Cresson Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Sellers & Co., Wm., Phila., Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Woods Sons Co., T. B., Chambersburg, Pa.

Cranes
Alliance Machine Co., Alliance, Ohio.
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, Ohio.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, Ohio.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co., Mfg. Co., St. Louis, Mo.
Frevert Machinery Co., New York.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg Co., New York.

Cranes, Portable
Nicholls, Wm. S., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.

Crank Shafts
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

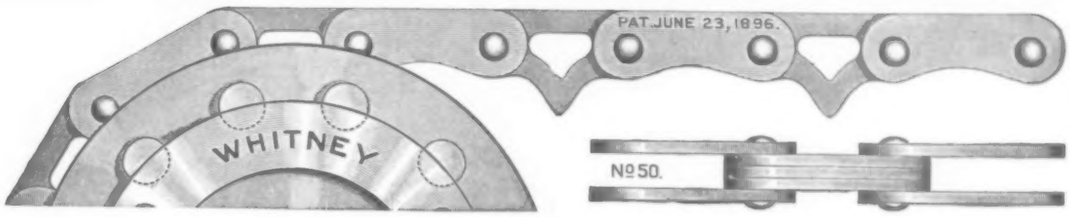
Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

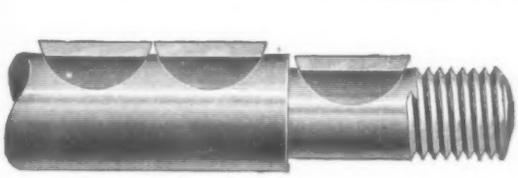
Crushers
Ingersoll-Rand Co., New York.
Link-Belt Engineering Co., Philadelphia, Pa.

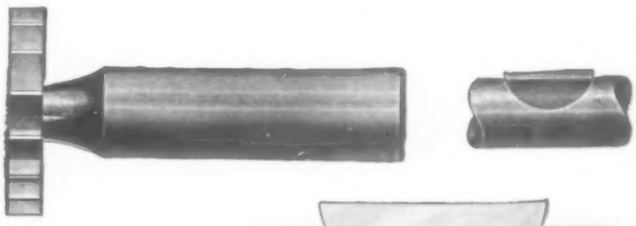
Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

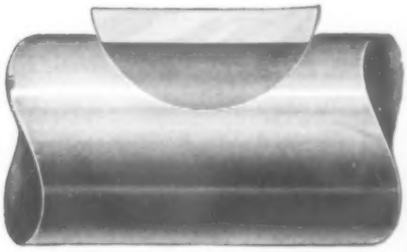
Cups and Covers, Oil
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Elliott Chemical Works, Newton, Mass.

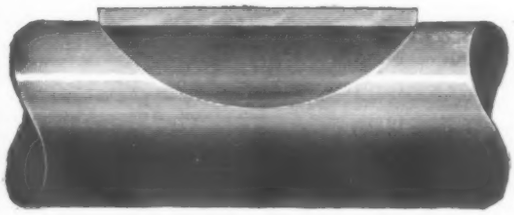
Cut Meters
Niagara Tachometer & Inst. Co., Niagara Falls, N. Y.
Warner Instrument Co., Beloit, Wis.











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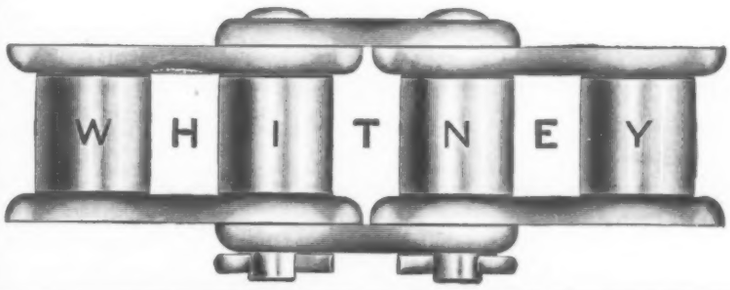
and

"WHITNEY" CHAINS

have been adopted by most of the leading manufacturers of

AUTOMOBILES, MACHINERY,

etc.



THE

WHITNEY MFG. CO.,

Hartford, Conn., U.S.A.

Cutters, Milling

Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Ingersoll Milling Mach. Co., Rockford, Ill.
International High Speed Steel Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines

Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Mach. Co., Pittsburg, Pa.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Machine Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-off Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools

Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Dies, Drop Forging

National Tool & Stamping Co., Philadelphia, Pa.

Dies, Sheet Metal

Amerian Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Kent & Co., Edwin R., Chicago, Ill.

Dies, Sub-Press

Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening

Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Drawing Boards and Tables

Keuffel & Esser Co., New York.
Obermayer Co., S., Cincinnati, O.
Rich, J. & G., Philadelphia, Pa.

Drawing Materials

Keuffel & Esser Co., New York.
Rich, J. & G., Philadelphia, Pa.
Soltmann, E. G., New York.

Drafting Machines

Universal Drafting Mach. Co., Cleveland, O.

Drift Bolt Drivers

Ingersoll-Rand Co., New York.

Drilling Machines, Bench

American Watch Tool Co., Waltham, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Dwight Slate Machine Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Boiler

American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Multiple Spindle

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Dwight Slate Machine Co., Hartford, Conn.
Fenn-Sadler Mach. Co., Hartford, Conn
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Three Rivers Tool Co., Three Rivers, Mich.

Drilling Machines, Portable

Cincinnati Elec Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York

Drilling Machines, Radial

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mach Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Drilling Machines, Turret

Niles-Bement-Pond Co., New York

Drilling Machines, Upright

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinati, O.
Davis Machine Co., W. P., Rochester, N. Y.
Dwight Slate Machine Co., Hartford, Conn
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.

Drilling Machines, Upright —*Continued.*

Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center

Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand

Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co, New York.

Drills, Pneumatic

Chisholm & Moore Mfg. Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York

Drills, Rail

Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co, New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock

Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drying Apparatus

Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N.J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley-G. I. Elec. Mfg Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Dynamotors

Sprague Elec. Co., New York.

Electrical Supplies

D'Olier & Co., H., Phila., Pa.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.

Electrical Supplies—*Cont'd.*

Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley-G. I. Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery

American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators

Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.

Emery Wheels

See Grinding Wheels

Emery Wheel Dressers

Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.

Enclosures, Tool-room

Hart & Cooley, New Britain, Ct.
Merritt & Co., Philadelphia, Pa.

Engineers, Consulting, and Mechanical

Dodge & Day, Philadelphia, Pa.

Engineers, Electrical

Crocker-Wheeler Co., Ampere, N. J.
Dodge & Day, Philadelphia, Pa.

Engines, Automobile

Franklin Mfg. Co., Syracuse, N. Y.
Olds Gas Power Co., Lansing, Mich.
Reeves Pulley Co., Columbus, O.

Engines, Gas and Gasolene

Automatic Mach. Co., Bridgeport, Conn.
Blaisdell Machinery Co., Bradford, Pa.
Foos Gas Engine Co., Springfield, Ohio.
Foss Gasoline Engine Co., Kalamazoo, Mich.
Greendale Gas Engine Co., Worcester, Mass
Jacobson Mach. Mfg. Co., Warren, Pa.
Mathews, Hugh, Kansas City, Mo.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, O.
Olds Gas Power Co., Lansing, Mich.
St. Marys Mach. Co., St. Marys, Ohio.
Struthers-Wells Co., Warren, Pa.

Engines, Gas

Backus Water Motor Co., Newark, N. J.

Engines, Oil

Mietz, August, New York.

Engines, Steam

Buffalo Forge Co., Buffalo, N. Y.
Garden City Fan Co., Chicago, Ill.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery

Gorton Mach. Co., Geo., Racine, Wis.
Roovers Bros., New York.

Exhaust Heads

Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition Machinery

Philadelphia Bourse, Phila., Pa.
Abel, C. C., New York.

Expanders, Boiler Tube

Nicholson & Co., W. H., Wilkesbarre, Pa.

Fans, Electric

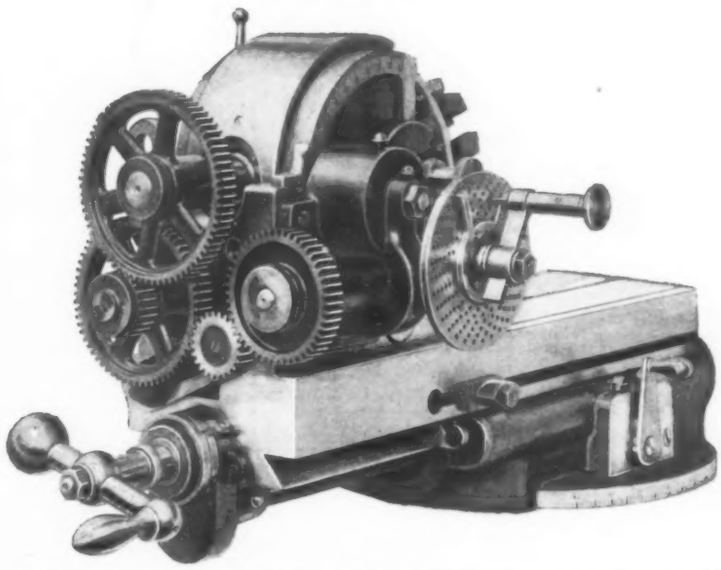
Crocker-Wheeler Co., Ampere, N. J.

BROWN & SHARPE MFG. CO.,

Providence, R. I., U. S. A.

RAPID AND PLAIN INDEXING

Accomplished on a B. & S. Spiral Head without throwing the Worm and Wheel out of mesh.



Original accuracy is always maintained.

The spindle is firmly held by means of a powerful friction device, which will stand the heaviest cuts within the capacity of the Spiral Head.

Other Features.

DIFFERENTIAL INDEXING.

With the 3 Index Plates and the Change Gears furnished, all divisions to 382 can be obtained.

GRADUATED INDEX SECTOR.

Enables the sector arms to be set quickly.

ADJUSTABLE INDEX CRANK.

Allows crank to be brought to the nearest hole without disturbing the setting of the work.

This Head is regularly furnished with all B. & S. Universal Milling Machines.

DIFFERENTIAL INDEXING BOOKLET

gives detailed description of Rapid Indexing. Sent to any address.

Fans, Electric—*Continued*
Diehl Mfg. Co., Elizabethport, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley-G I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Feathers
Standard Gauge Steel Co., Beaver Falls, Pa.

Files and Rasps
Barnett Co. G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichheim & Co., E. P., New York.

Filing Machines
Cochrane-Bly Co., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Elmira Machine Works, Elmira, New York.
Grant Mfg. & Machine Co., Bridgeport, Conn.
Henry & Wright Mfg. Co., Hartford, Conn.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co. Pittsburg, Pa.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Rand Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Crescent Forging Co., Oakmont, Pa.
Monarch Wrench Works, St. Louis, Mo.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Baldwin Steel Co., New York.
Boker & Co., Hermann, N. Y.
Crescent Forgings Co., Oakmont, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon Co., Worcester, Mass.

Foundry Furnishings
Adams Co., Dubuque, Iowa.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers
Sturtevant Co., B. F., Hyde Park, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Tate, Jones & Co., Pittsburg, Pa.

Furnaces, Enameling
American Gas Furnace Co., N. Y.

Furnaces, Gas
American Gas Furnace Co., N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Obermayer Co., S., Cincinnati, O.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., N. Y.

Furnaces, Oil
Tate, Jones & Co., Pittsburg, Pa.

Furnaces, Rivet
Tate, Jones & Co., Pittsburg, Pa.

Furniture, Machine Shop
Hart & Cooley Co., New Britain, Conn.
Manufacturing Equip. & Engineering Co., E. Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co. New Britain, Conn.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Boston, Mass.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Mass. Tool Co., Greenfield, Mass.
Morse Twist Drill & Mach. Co., New Bedfrd, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bilgram, Hugo, Philadelphia, Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Machine Co., Hartford, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co, New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sloan & Chace Mfg. Co., New ark, N. J.
Walcott & Son, Geo. D., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach Co., New Bedford, Mass.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mach. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
New Process Rawhide Co., Syracuse, N. Y.

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Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cin., O.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Rawhide
Boston Gear Works, Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mach Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., The, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

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Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.
Van Dorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

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American Gas Furnace Co., New York.

Gibs
Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite
Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Automatic Knife
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg Co., Worcester, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Bath Grinder Co., Fitchburg, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, Ohio.
Crocker-Wheeler Co., Ampere, N.J.
Dayton Machine & Tool Works, Dayton, O.

Grinders, Cutter—*Continued*
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett-Dock Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Cylindrical
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk
Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov, R. I.
Gardner Machine Co., Beloit, Wis.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.

Grinders, Drill
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinders, Piston Ring
Heald Mach. Co., Worcester, Mass.

Grinders, Portable
Cincinnati Electrical Tool Co., Cincinnati, O.
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Machine Co., Cincinnati, O.
Landis Tool Co, Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, Ohio.
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Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hratford, Ct.

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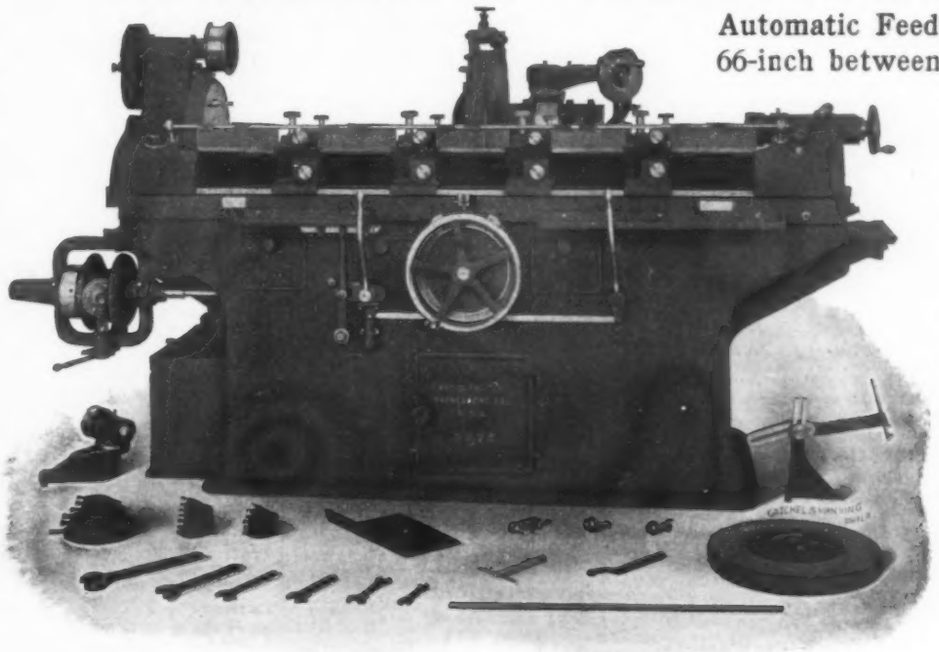

This machine is adapted for finishing straight and taper spindles, shafts and such other parts within its range.

The Head-stock is compound geared and gives a powerful drive on all work speeds.

The Automatic Cross Feed will size work accurately to one-quarter thousandth of an inch. Landis Machines are made for work and wear—and stand it. Send us a piece of work to finish on a Landis. Judge the quality and know the exact time taken.

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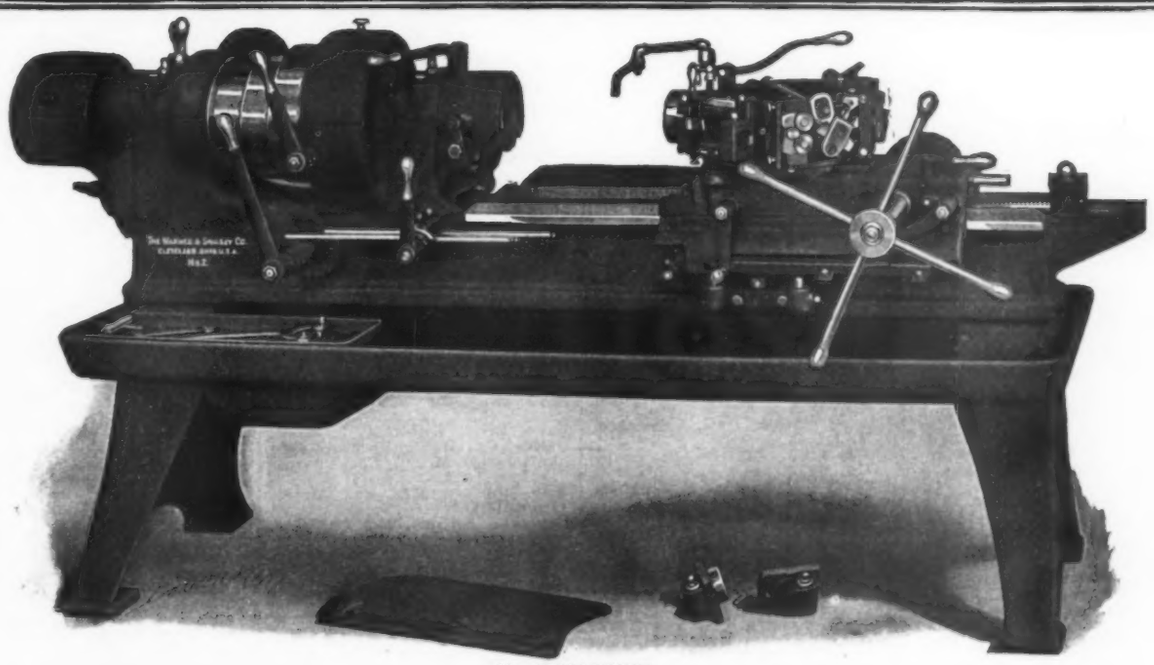

No. 2 MACHINE.

Hollow Hexagon Turret Lathes

THREE SIZES:

No. 1—1⅜ x 15, No. 2—2¼ x 24, No. 3—3⅝ x 36"

FOR RAPID PRODUCTION

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Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
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Greenfield Mach. Co., Greenfield, Mass.
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Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Independent Pneumatic Tool Co., Chicago, Ill.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Royersford Fdry. & Mach. Co., Royersford, Pa.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
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Builders' Iron Foundry, Providence, R. I.
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Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
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Niles-Bement-Pond Co., New York.

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Pratt & Whitney Co., Hartford, Conn.

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Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

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Chisholm & Moore Mfg. Co., Cleveland, O.
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Dayton Pneumatic Tool Co., Dayton, O.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Sellers & Co., Wm., Phila., Pa.

Hammers, Power

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Fairbanks Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Scranton & Co., The, New Haven, Conn.

Hammers, Steam

Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Crescent Forgings Co., Oakmont, Pa.
Marshall & Huschart Machinery Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Handles, Machine Tool

Whitman & Barnes Mfg. Co., Chicago, Ill.

Handles, Screw Plate

Standard Welding Co., Cleve., O.

Hangers, Shafting

Cresson Co., Geo. V., Phila., Pa.
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Hyatt Roller Bearing Co., Harrison, N. J.
Link-Belt Engineering Co., Philadelphia, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

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Sturtevant Co., B F., Hyde Park, Mass.

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Sturtevant Co., B F., Hyde Park, Mass.

Heating Machines

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Chicago Flexible Shaft Co., Chicago, Ill.

Hoisting and Conveying Machinery

Alliance Machine Co., Alliance, O.
Brown Hoisting Machinery Co., Cleveland, O.
Case Mfg. Co., Columbus, Ohio.
Caldwell & Son Co., H. W., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Cresson Co., Geo. V., Phila., Pa.
Jeffrey Mfg. Co., Columbus, O.
Lamson Consolidated S. S. Co., Boston, Mass.
Link-Belt Engineering Co., Philadelphia, Pa.
Main Belting Co., Phila., Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
United Engineering & Fdry. Co., Pittsburg, Pa.

Hoists, Electric

C & C Electric Co., New York.
Case Mfg. Co., Columbus, Ohio.
Cleveland Crane & Car Co., Wickliffe, O.
Crocker-Wheeler Co., Ampere, N. J.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Frevert Machinery Co., New York.
General Electric Co., New York.
General Pneu. Tool Co., Montour tour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand

Case Manufacturing Co., Columbus, Ohio.
Chisholm & Moore Mfg. Co., Cleveland, O.
Frevert Machinery Co., New York
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Moore Co., Franklin, Winsted, Conn.
Nicholls, Wm. S., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic

Chisholm & Moore Mfg. Co., Cleveland, Ohio.
Curtis & Co. Mfg. Co, St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Northern Engineering Works, Detroit, Mich.

Hose, Steel

Sprague Elec. Co., New York.

Igniters, Gas Engine

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Indicators, Speed

Niagara Tachometer & Inst. Co., Niagara Falls, N. Y.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral

Warner Instrument Co., Beloit, Wis.

Indicators, Steam Engine

Crosby Steam Gage and Valve Co., Boston, Mass.

Indicators, Test

Equipoise Rivet Co., Waterbury, Conn.
Norton Emery Wheel Co., Worcester, Mass.

Industrial Railways

Hunt Co., C. W., West New Brighton, N. Y.

Injectors

Desmond-Stephan Mfg. Co., Urbana, O.
International Specialty Co., Detroit, Mich.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspecton and Tests

Hunt Co., Robert W., Chicago, Ill.

Instruction Schools

See Schools, Correspondence

Instruments, Electric

General Elec. Co., New York.
Stanley-G. I. Electric Mfg. Co., Pittsfeld, Mass.

Iron Filler

Clark Cast Steel Cement Co., Shelton, Conn.

Jacks, Hydraulic

Bethehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer

Armstrong Bros. Tool Co., Chicago, Ill.

Kettles, Soda

Brown & Sharpe Mfg Co., Providence, R. I.

Key Seaters

Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Chattanooga Mchry. Co., Chattanooga, Tenn.
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Lapointe Machine Tool Co., Boston, Mass.
Marshall & Huschart Machy. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Gauge Steel Co., Beaver, Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knives, Shear

Phillips-Lafitte Co., Philadelphia, Pa.

Knurls

Hammacher, Schlemmer & Co., New York.

Lamps, Arc

General Electric Co., N. Y. City.
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent

General Elec. Co., New York.
Stanley-G. I. Electric & Mfg. Co., Pittsfield, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Lathe Attachments

American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Bradford Machine Tool Co., Cincinnati, Ohio.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Sloan & Chace Mfg. Co., Newark, N. J.

Lathe Dogs

Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Hill Standard Mfg. Co., Anderson, Ind.
LeCount, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

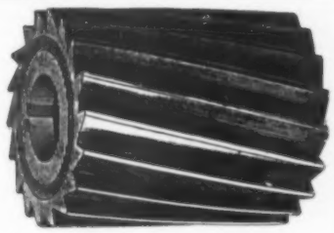
Lathes

American Tool Works Co., Cin., O.
Automatic Mach. Co., Bridgeport, Conn.
Barnes Co., W. F., & John, Rockford, Ill.
Bertram & Cons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport Conn.
Champion Tool Works Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Diamond Machine Co., Providence, R. I.
Dreses Mach. Tool Co., Cincinnati, O.
Fairbanks Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Conn.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Machry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sellers & C., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Springfield Mch. Tool Co., Springfield, Ohio.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Walcott & Son, Geo. D., Jackson, Mich.
Wells & Sons Co., F. E., Greenfield, Mass.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Lathes, Automatic Screw-Threading

Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

High Speed Milling



demands accurately ground Milling Cutters that will retain their clean, smooth cutting qualities under hard, continuous working in high power steel. The Cutter makers up in Athol furnish this kind. Try them.

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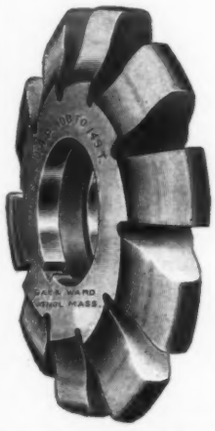

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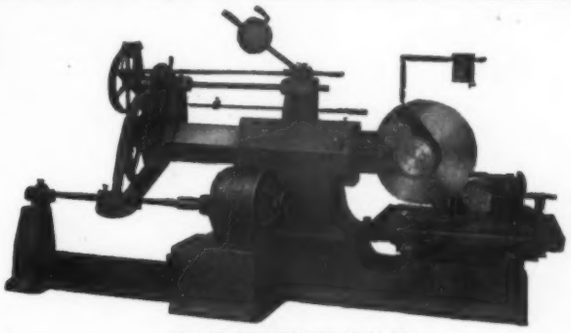
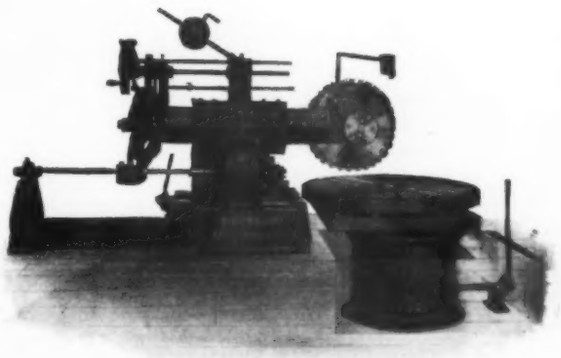


FLAT FOUNDRY TYPE



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Lathes, Bench

American Watch Tool Co., Waltham, Mass.
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Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark Tool Co., Waltham, Mass.
Sloan & Chace Mfg. Co., Newark, N. J.
Waltham Machine Works, Springfield, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring

Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Lathes, Brass

Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Dreses Mach. Tool Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York
Springfield Mch. Tool Co., Springfield, O.
Windsor Mach. Co., Windsor, Vt.

Lathes, Extension

Bertram & Sons Co., Ltd., Rundas, Ontario, Canada.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Prentiss Tool & Supply Co., New York.

Lathes, Foot Power

Barnes Co., W. F. & Jno., Rockford, Ill.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Lathes, Speed

Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Blount Co., J G., Everett, Mass.

Lathes, Wood

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Seneca Falls Mfg. Co., Seneca Falls, N. Y.

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Merritt & Co., Philadelphia, Pa.

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Dixon Crucible Co., Jos., Jersey City, N. J.

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Lunkenheimer Co,. Cincinnati, O.

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Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Motch & Merryweather Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Vandyck Churchill Co., New York.
Wormer Mach. Co., C. C., Detroit, Mich.

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Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Boker & Co., Hermann, New York.
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Diamond Saw & Stamping Works, Buffalo, N. Y.
Hammacher, Schlemmer & Co., New York.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.
U. S. Watch Tool Co., Rochester, N. Y.
Zange, M., Ilion, N. Y.

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Whitman & Barnes Mfg. Co., Chicago, Ill.

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Nicholson & Co., W. H., Wilkes-Barre, Pa.

Mandrels, Solid

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Independent Pneumatic Tool Co., Chicago, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Schellenbach & Darling Tool Co., Cincinnati, O.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Marking Machines

Dwight Slate Machine Co., Hartford, Conn.

Measuring Machines

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Niles-Bement-Pond Co., New York
Rivett Lathe Mfg. Co., Boston, Mass.
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Niles-Bement-Pond Co., New York
Rivett Lathe Mfg. Co., Boston, Mass.
Waltham Mach. Tool Co., Springfield, Mass.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Horizontal

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Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Cincinnati Milling Machine Co., Cincinnati, O.
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Hess-Bright Mfg. Co., Phila., Pa.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Kempsmith Mfg. Co., Milwaukee, Wis.
Newton Machine Tool Works, Philadelphia, Pa.
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Pratt & Whitney Co., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

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Becker-Brainard Milling Machine Co., Hyde Park, Mass.
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Cincinnati Milling Mach. Co., Cincinati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Kempsmith Mfg. Co., Milwaukee, Wis.
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Marshall & Huschart Machry. Co., Chicago, Ill.
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Whitney Mfg. Co., Hartford, Ct.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Conn.
Kempsmith Mfg. Co., Milwaukee, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

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Adams Co., Dubuque, Iowa.
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Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Bertram & Sons Co., Ltd., Dundas, Ontario, Canada.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Garvin Mach. Co., New York.
Ingersoll Milling Mach. Co., Rockford, Ill.
Newton Mach. Tool Works, Philadephia, Pa.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

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Pans, Lathe

New Britain Mach. Co., New Britain, Conn.

Pans, Shop

New Britain Mach. Co., New Britain, Conn.

Patents

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Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

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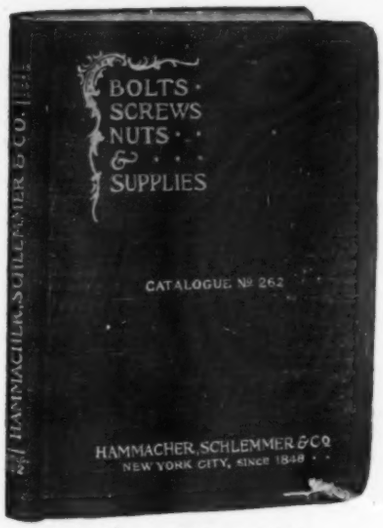
Phosphor Bronze Smelting Co., Philadelphia, Pa.



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Detrick & Harvey Mch. Co., Baltimore, Md.
Fairbanks Co., New York.
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Garvin Mach. Co., New York.
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Presses, Forging
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Ingersoll-Rand Co., New York.

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Sellers & Co., Inc., Wm., Philadelphia, Pa.

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Sellers & Co., Inc., Wm., Philadelphia, Pa.

Punches, Hydraulic
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Niles-Bement-Pond Co., New York.
United Engineering & Fdry. Co., Pittsburg, Pa.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Royersford Fdry. & Mach. Co., Royersford, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
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Walcott & Son, Geo. D., Jackson, Mich.

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Fellows Gear Shaper Co., Springfield, Vt.
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LeBlond Mach. Tool Co., R. K., Cincinnati, Ohio.
Nuttall Co., R. D., Pittsburg, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
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Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Schellenbach & Darling Tool Co., Cincinnati, O.
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Three Rivers Tool Co., Three Rivers, Mich.
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Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
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Hess-Bright Mfg. Co., Phila., Pa.
Hyatt Roller Bearing Co., Hartson, N. J.

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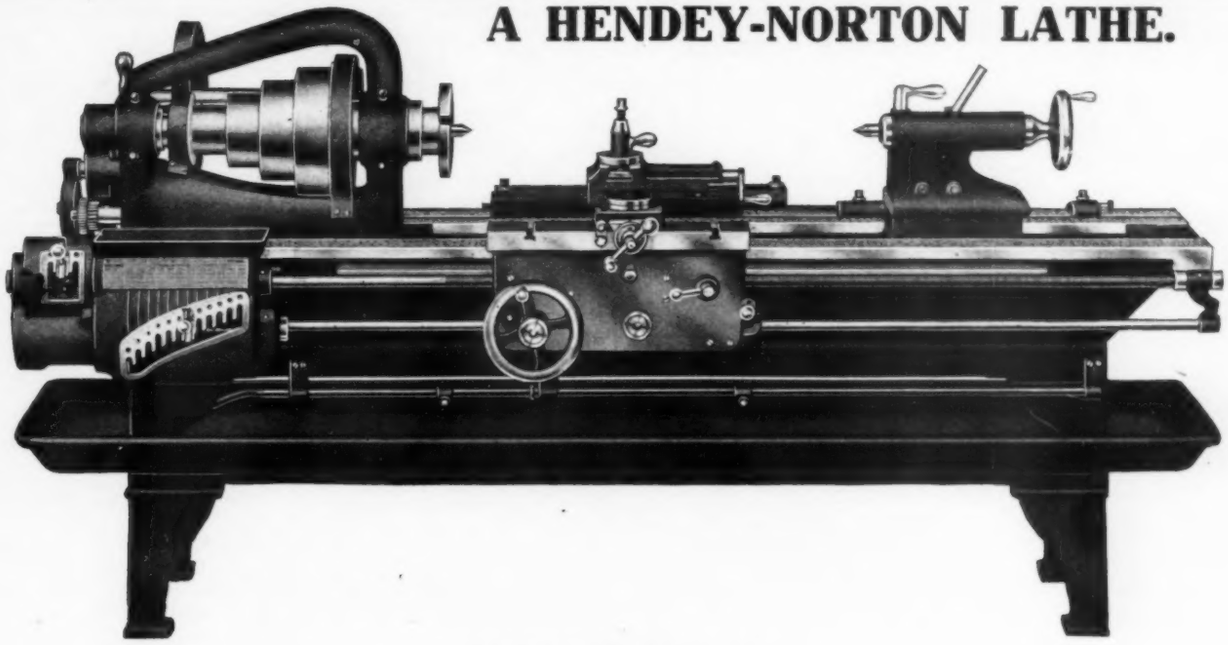

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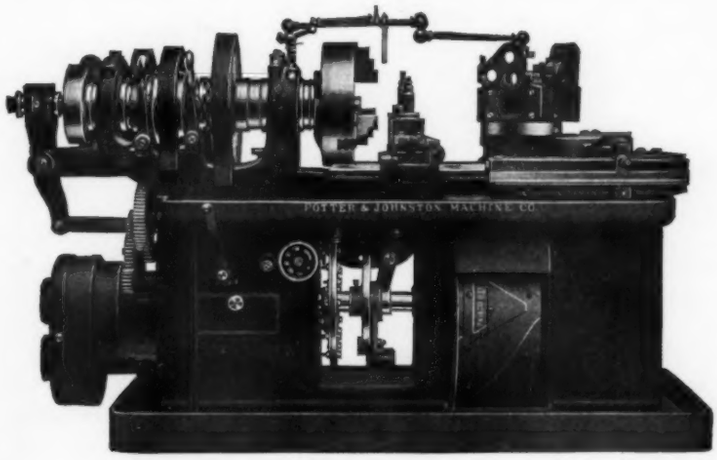

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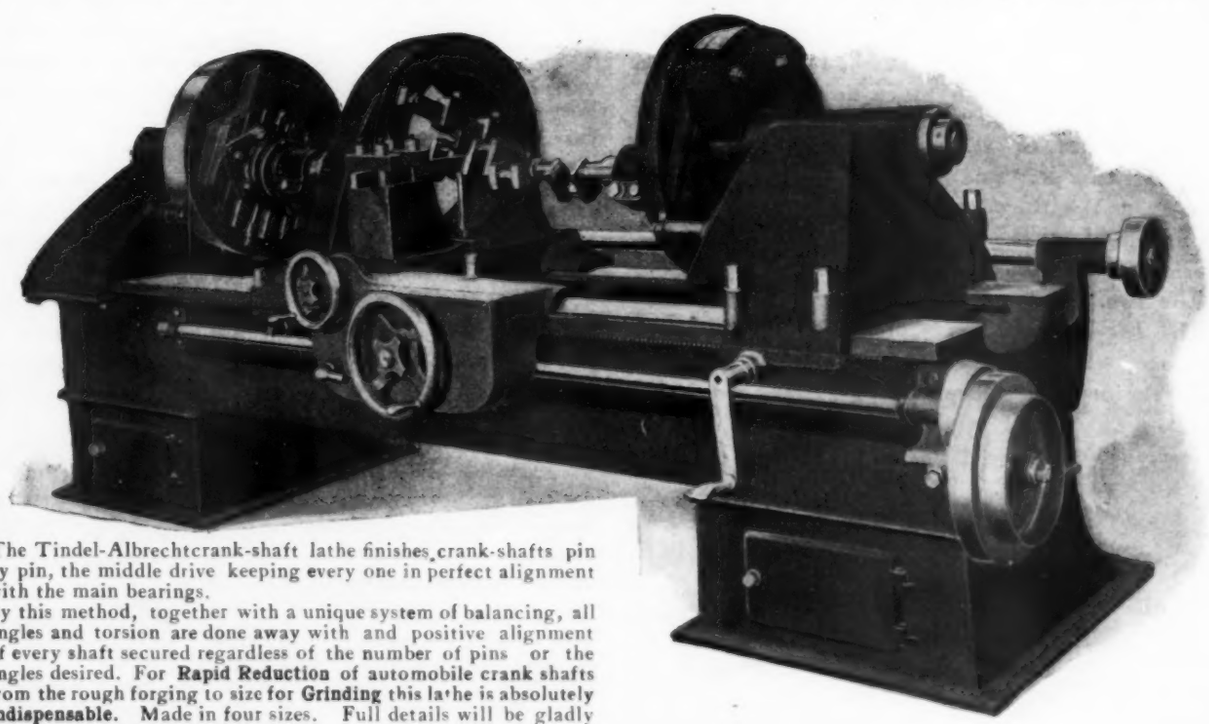

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Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Merrill Bros., Brooklyn, N. Y.
Parker Co., Chas., Meriden, Conn.
Reed Mfg. Co., Erie, Pa.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders Sons, D., Yonkers, N. Y.
Reed Mfg. Co., Erie, Pa.

Vises, Planer and Shaper
American Tool Wks. Co., Cin., O.
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Conn.
Niles-Bement-Pond Co., New York.

Vises, Universal Machine
Graham Mfg. Co., Prov., R. I.

Vise Stands, Portable
Le Blond Mach. Tool Co., R. K., Cincinnati, Ohio.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Parker Co., Chas., Meriden, Conn.
Wyman & Gordon, Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

Welding
Goldschmidt Thermit Co., New York.

Welding, Electric
American Tube & Stamping Co., Bridgeport, Conn.
C & C Electric Co., New York.
Standard Welding Co., Cleveland, Ohio.

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Long & Allstatter Co., Hamilton, Ohio.

Welding Plates
Phillips-Laffitte Co., Phila., Pa.

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Crosby Steam Gage and Valve Co., Boston, Mass.

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General Electric Co., New York.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.

Wire-Forming Machinery
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Prentiss Tool & Supply Co., New York.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

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Gould & Eberhardt, Newark, N. J.
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Monarch Wrench Works, St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.
Wyman & Gordon, Worcester, Mass.

Wrenches, Machinists'
Bay State Tool Co., Worcester, Mass.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
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Bullard Auto Wrench Co., Providence, R. I.
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Patterson, Gottfried & Hunter, Ltd., New York.
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Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bullard Automatic Wrench Co., Providence, R. I.
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Patterson, Gottfried & Hunter, Ltd., New York.
Reed Mfg. Co., Erie, Pa.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Wrenches, Ratchet
Bay State Tool Co., Worcester, Mass.
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Card Mfg. Co., S. W., Mansfield, Mass.
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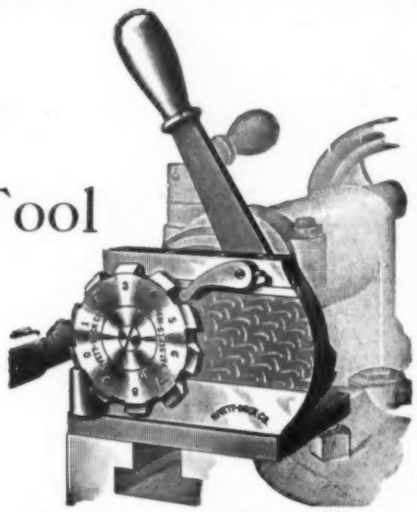

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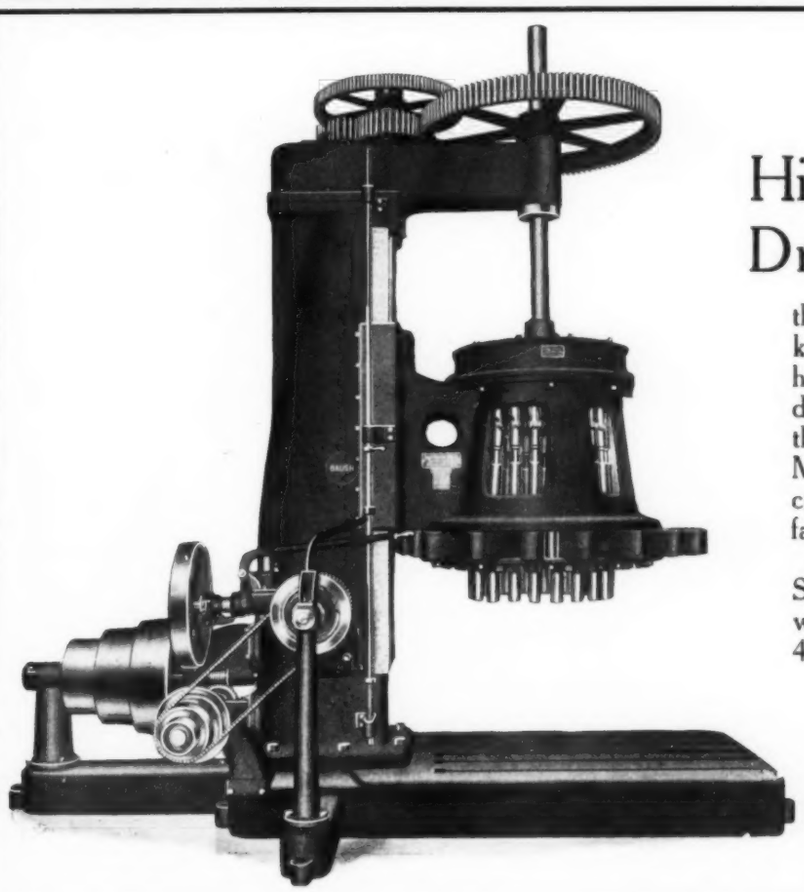

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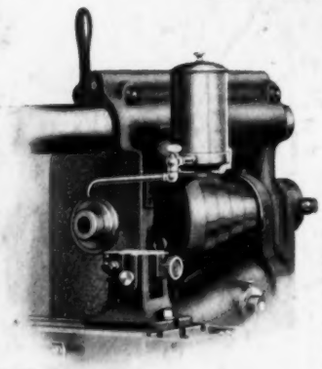

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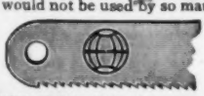

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